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SUPPLEMENT---XI.

REVIEWS.

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On taking a review of the progress made by the human mind in the various departments of science, from periods of remote antiquity, it is a circumstance calculated to excite some surprise, that the study of the earth itself—of that planetary body on which we live and move and have our being," should have been disregarded, and have entirely escaped the attention of mankind till within the period of the last half century. Astronomy had penetrated into the regions of space to distances of which the mind can form no adequate conception, had reduced the complex motions o the planetary system to the simple and universal law of gravitation, and revealed truths so sublime, that the human intellect is ennobled by their perception. The abstract sciences had been pushed almost to their extremest verge—natural philosophy had made vast progress in all its various departments—the subtile properties of the electric fluid had been scrutinised, and the bold experiment of Franklin had drawn lightning from the sky—before attention was directed to the structure of the globe which we inhabit; its more obscure relations to the wants of man, and the mighty physical revolutions which it has undergone, and which have left such enduring marks upon its surface.

This singular neglect of one of the most interesting, and apparently most obvious branches of scientific research, was doubtless the result of many causes, to one or two of which only we shall here allude. The spirit of ancient philosophy disdained the slow and laborious process of patiently investigating natural phenomena; and it was not till the lofty, but severe, genius of Bacon had firmly established the inductive system of philosophy, that a science like geology could be cultivated with success.

It was necessary also that the kindred sciences of chemistry and mineralogy should have made considerable progress before any successful inquiry could be instituted into the nature of the earth, and the position and relations of its constituent masses. Another obstacle to the cultivation of geological science, at an earlier period, arose from the obscurity in which the phenomena which it investigates are veiled by Nature. The internal parts of the earth are, with few exceptions, excluded from our view; those portions exposed to our examination are "few and far between," often indeed obscure and deceptive: and thus it happens that numerous and accurate observations, and extensive powers of generalisation, were required, before the science of geology could be placed on a firm foundation, and attract that attention which it deserved.

To have accomplished this important task fell to the lot of Werner, who is deservedly looked up to, as almost the father of geological science. Many important facts had previously been observed, and many remarkable anticipations had been indulged in by different gifted individuals, but it was reserved for Werner to combine these scattered fragments—to add to them his own extensive observation and precise mineralogical knowledge, and finally to combine these materials into an apparently beautiful and harmonious, though, as it has since been proved, faulty and inconsistent theory—a circumstance so far unavoidable in an infant science, that it detracts but little from his great and original merits. The profession of Werner, as a miner, gave him numerous and valuable facilities for personal observation of geological phenomena: the principal errors into which he fell were those of supposing that the limited portion of Germany with which he was acquainted, might be considered as representing the structure of the whole globe; and as the operation of existing geological causes was then very imperfectly understood, he was too hastily led to admit of explanations founded on imaginary phenomena and gratuitous assumptions.

Our countryman, Hutton, and his able illustrator, Playfair, were well acquainted with the phenomena of the older and pyrogenous rocks, and established on their observations a bold, and in many respects a just, theory, but almost entirely opposed to that of Werner, and in the discussion and support of these opposite views, too much of the attention of the earlier geologists was unfortunately directed.

Hasty and immature theories, founded on imperfect knowledge, warmly espoused, and keenly contested, were ill calculated to advance an infant science; and in the early part of the present century a clear perception of this truth appears to have prevailed among many of the principal cultivators of geological science in this country. It was seen by them that a vast collection of *facts*, apart from theoretical considerations, was at that period the great object to be attained, that a concentration of all their powers to effect this great and laborious task was requisite; that frequent meetings and communications between geologists could alone remove the narrow and limited views then entertained; and that finally a convenient and accessible depository for their labours was essential.

These, we believe, were the considerations which chiefly influenced the founders of the Geological Society, which was first established in 1807, and for some time consisted of little more than the private meetings of some of the chief cultivators of geological science in this country. It is unnecessary for us to trace the progress of this Society from a small beginning to its present high and palmy state:" the numerous volumes of Transactions which have been published, bear witness to the zeal and energy with which it has laboured; and the names of Greenough (one of its earliest supporters), of Lyell, Buckland, Sedgewick, Murchison, De la Beche, and many others, are sufficient to prove the high degree of talent enrolled among its members.

The recently published volume of the Transactions of the Geological Society, now before us, contains, as usual, several valuable papers on different departments of geology, illustrated by numerous and excellent plates, illustrative of the subjects treated on. Full three-fourths of the volume is occupied by the elaborate paper of Dr. Fitton, on the "Strata below the Chalk;" to the examination of which he is well-known to have devoted considerable attention. There is also an excellent paper by Professor Sedgewick, on the "New Red Sandstone in the Basin of the Eden;" by Colonel Sykes, on the "Geology of the Dekun;" by Mr. Horner, on the "Environs of Bonn," together with some shorter articles; but we regret to find no papers connected with mining, or attempting to elucidate the curious and highly important phenomena observed in our mineral districts. It is true, that in the wide field of geological science, the subjects we allude to can receive but a limited and proportional share of attention; yet when we consider their immense importance, and the light which science has been enabled to throw on many species of practical operations, we cannot but regret to find that our mines and mineral deposits occupy *generally*, so small a space in the Transactions of the Geological Society, and benefit so little by the energy and talent which it possesses. The phenomena of primary geology and of metalliferous veins have received great attention from the more recent society established at Penzance, and have been most ably illustrated by its labours; yet we would still look to the Geological Society of London for its co-operation in this extensive and important field.

Proceeding to the volume before us, our first notice will be directed to Dr. Fitton's elaborate memoir, which, as before observed, occupies a large portion of its pages. It is entitled "Observations on some of the Strata between the Chalk and the Oxford Oolite, in the South-east of England," and we quote the following introductory passages, as best explaining the author's views:—

"In a paper published in the 'Annals of Philosophy' for November and December 1824, I gave an account of the order and characters of the strata which occur beneath the chalk on the coast of part of the Isle of Wight and of Dorsetshire, and stated some reasons for supposing that a similar arrangement would be found to exist in the interior of England.

"The principal objects of that paper were; *First*, to distinguish as a separate group, the series of strata now called the lower green-sand;—which had previously been confounded either with the beds containing green particles immediately below the chalk, or with the sandy and ferruginous strata conspicuously exhibited on the coast at Hastings, and then called 'iron-sand.' *Secondly*, to indicate more clearly than had been done before, the peculiar characters of the group, which succeeds in a descending order to that just mentioned, and is remarkably distinguished by its fossils from the strata immediately in apposition with it, both above and below. For this latter group, which includes the Weald clay, the sand of Hastings, and the Purbeck limestone, and is well entitled to a separate denomination, I have adopted the name of '*Wealden*,' proposed by Mr. Martin, in his valuable memoir on the West of Sussex.

"The objects of the inquiries which have produced the following pages were, to compare some portions of the series of strata between the chalk and the Oxford oolite, in different parts of the south-east of England; to ascertain the existence of the Wealden in the interior; and if possible, to determine its boundaries.

"In stating the result of this investigation, I shall give a series of sections of the strata below the chalk, at places which I have myself examined, beginning on the coast near Folkstone, and following the outline of the chalk thence to the sea on the north west of Norfolk. The relative situation of these places is shown in the map annexed to this paper. The intermediate country, in general, I have not examined in detail, and some points of importance I have never seen; but those who may have opportunities of continuing the enquiry, will find, I hope, no difficulty in connecting their observations with mine.

"The series of strata about to be described extends from the chalk down to the Oxford oolite or coral-rag, and is composed of alternating but irregularly distributed beds of sand, clay, and stone.

"Among the sandy strata, it is important to discriminate not only between the lower green sand and that of Hastings, but to distinguish both from a third group, consisting principally of sand abounding in green particles, which lies beneath the Portland stone.

"Clay, of several varieties, occurs in all parts of this series; but three groups, constituting the gault, the weald-clay, and the Kimmeridge-clay, derive peculiar importance from their generally occupying valleys, or depressions, at the foot of the escarpments of the chalk, the lower greensand, and the Portland stone, respectively, and thus producing conspicuous natural features in the tracts where this succession is observable.

"The stone of the tracts under consideration is either limestone; indurated sand-rock; chert; or siliceous matter intimately mixed with carbonate of lime, in the form of grit,—which has commonly a concretional structure, and seems to pass into continuous beds only by the approach and ultimate union of the concretions.

"But the most remarkable distinction, in the suite described in this paper, arises from the great difference of character in the organized remains which the principal groups include. The fossils of the chalk and green-sands and those of the Portland stone, are all marine, and the species numerous. But in the *Wealden*, between the lower green sand and the Portland stone, although the fossils are abundant as to quantity, the species are comparatively few, and by far the greater part of them belongs to fresh water. The whole of the phenomena, in short, presented by this remarkable assemblage of beds, are such as to accord with the hypothesis of their having been deposited in fresh water communicating with the sea.

"Combining these sources of distinction, the following arrangement and sub-divisions may be adopted, the nomenclature of which, however exposed to criticism, is now probably too well established to be changed without inconvenience.

CHALK	*Upper.* *Lower.* *Marly.*	Fossils, marine: species numerous.
GREEN-SAND	*Upper green-sand.* *Gault.* *Lower green-sand.*	
WEALDEN....	*Weald-clay.* *Hastings sands.* *Purbeck strata.*	Fossils, for the greater part of fresh water: species few.
	Portland stone.	Fossils, marine: species numerous.
Part of the OOLITIC SERIES	*Portland sand.* *Kimmeridge and Weymouth clay and sand.*	
	Oxford oolite (Coral rag).	

"I proceed now to describe the sections of these strata, beginning with the coast of Kent; and I shall connect with each section a list of such fossils as I have either found myself, or obtained on good authority from the places mentioned. The whole of the shells in these lists have been examined and named by Mr. James Sowerby, by whom also the drawings of the supposed new species were made, and the annexed engravings executed. It is right to mention this explicitly, both that I may take the opportunity of expressing my acknowledgments for Mr. Sowerby's valuable and assiduous co-operation,—and that, being myself but very slightly acquainted with conchology, I may place the portion of the following pages which relates to that subject on better authority than my own."

After thus noticing the general objects of the paper, we shall proceed to extract some of the most interesting passages.

The scanty mineral contents of the gault are thus noticed—

"Throughout the gault, but chiefly in the inferior portion, concretions of iron pyrites are found, generally approaching to a globular or cylindrical figure, and of a radiated crystalline structure within, or in long thin vermicular rods, which at first sight might be taken for vegetable stems. On the opposite coast of France, near Wissant, the pyrites is so abundant in the gault as to have given origin, some years since, to a manufactory of sulphate of iron; but near Folkstone the quantity is comparatively inconsiderable."

The curvatures and dislocation of the strata, which are proved both by natural sections and by mining operations, to be so frequent in the older formations, are now well-known to be almost equally common among the more recent ones, although there are, of course, fewer opportunities of observing them. Dr. Fitton has figured several strongly marked anticlinal axes, occuring in the sand below the chalk, and giving rise to ridges and elevations on the surface.

The bold range of hills, called the "Hindhead," forming the elevated and sterile region, crossed by the road from London to Portsmouth, between Godalming and Petersfield, is thus described:—

"The crest of Hindhead is on the north-east of a depression called the 'Devil's Punchbowl,' round which the road is conducted. The highest part of the curve, or anticlinal bending of the lower greensand, seems to be just at a point where the new road, on a lower level than the old, has exposed a face of ten to twenty-five feet in height. The flexure is very slight, but sufficiently perceptible, occurring in such a place, to be deserving of notice. The strata consists of soft sand-rock, containing concretions, and nearly continuous beds of chert, passing into chalcedony, of various shades of yellow and brown; with occasional layers of bright yellowish sand, in which the lines of false stratification are conspicuous. All over Grayshot Down the sub-soil is a soft loose sand of the same description.

"The whole of the tract here occupied by the sands, though not unpicturesque, is wild and barren in its aspect, destitute of wood, producing only ferns, heath, and furze. The surface is, in fact, to this hour nearly such as it may be conceived to have been when first uncovered by the departure of the sea; and its structure is just what may be imagined to result from the levelling effect of water under the influence of motion of no great violence. In crossing this desolate region by the main road from London to Portsmouth, it is difficult to believe that we are only forty miles distant from the capital, and midway to one of the chief naval establishments of the empire: but the nature of the soil effectually prevents improvement, and it is not improbable that this tract may remain for centuries unchanged, and still exemplify the power of geological causes in modifying the civil condition of countries, as well as their external features."

The formation which furnishes the well-known "Portland stone," is thus noticed:—

"This formation first appears upon the coast beneath the Purbeck strata at Durlstone Head, and rises slowly in the rocky cliffs on the west of Tillywhim to a point about midway between Winspit and St. Alban's Head, where it is succeeded by the Portland sand. The stony strata there retire as they rise from the shore, and occupy the margin of an irregular space thence to Gad Cliff, where they return to the coast and sink under the sea: so that between the extreme points of Durlstone Head and Gad Cliff (or rather Worbarrow Knob, a rocky hummock on the west of that place), a real curvature combined with the general inclination of the strata towards the north, which is in some places very rapid, has caused an extensive disclosure of the lower beds, excellent sections of which are visible on the west of St. Alban's Head. The component strata of the Portland stone in Purbeck, agree with those of the Isle of Portland, which have been described by Mr. Webster.

"*Portland stone.*—I propose to give this name to a group of strata which holds the place of that mentioned by Mr. Conybeare, as occurring beneath th e equivalent of the Portland stone at Shotover Hill in Oxfordshire, and in Bucks; and which in the interior contains a large proportion of sand, including green particles, ascertained by Dr. Turner to be of the same composition with those of the green sands beneath the chalk. I have found a similar group abounding in green matter, and containing, as at Shotover, very large concretions of grit, in a corresponding place in the lower Boulonnois, where a great part of the formation consists of sand. But on the Dorsetshire coast, and I believe, in the vale of Wardour also, the beds are generally of a dark grey colour, more coherent, less sandy, and the calcareous matter which they contain, is more uniformly diffused. The group is certainly of sufficient importance to require a separate name, and that of *Portland sand*, while it expresses the more usual character, indicates also its intimate connexion with the Portland stone. On the other hand, it graduates into the Kimmeridge clay beneath; and its position seems to be analogous to that of the sand and subcalcareous grit which occur between the Oxford oolite and Oxford clay,—the inferior oolite and the lias clay: ? The whole mass of strata deposited in the first instance, having been in all these cases, sand and mud; the upper part of which abounding more in calcareous matter, was subsequently converted into stone, and the lower more or less concreted into nodular masses of calcareous grit, in proportion to the quantity of carbonate of lime diffused through it."

The bituminous portion of the Kimmeridge clay, sometimes affording an indifferent fuel, is thus noticed:—

"The beds here consist in general of bituminous fissile clay in a large proportion alternating with thin courses of brown subcalcareous stone, or bituminous limestone. The clay in some cases contains so much bituminous matter, as to be used for fuel under the name of 'coal;' in others it contains a large proportion of carbonate of lime, alternating with the laminæ of the clay. To these more calcareous and whiter beds, the name of 'white lias' is given in the neighbourhood."

The ancient alluvium forming the "dirt bed" of the Isle of Portland, which often contains the petrified trunks of trees, is thus described:—

"Mr. Webster, in his account of the strata above the Portland stone, has described a remarkable bed, called by the quarry-men the 'Dirt,' or 'Black dirt,' which he found to contain portions of the trunks of silicified trees; one of which he himself saw standing upright, and divided at the lower part, 'so as to give the idea of roots.' He states that these trunks were not found in any other part of the series; but not having seen any fossils in the beds above the Portland stone, he expresses himself with caution as to the place of the boundary between the Purbeck strata and the oolitic group beneath it; intimating, however, that it will probably be found at the top of the chert or flint in the upper part of the oolite. Some years afterwards Dr. Buckland described specimens of a new family of fossil plants from the 'Dirt-bed' above-mentioned; to which, at the suggestion of Mr. Brown, he gave the name of Cycadeoideæ, but which Mr. Adolphe Brongniart, adopting a different system of nomenclature, soon after formed into a genus, which he called Mantellia. Dr. Buckland was subsequently led to infer that the 'Dirt-bed' was actually the soil in which both the silicified trees and the Cycadeoideæ had grown: and in a paper read before the Society in 1830, now published in this volume, he and Mr. De la Beche have stated several facts respecting that remarkable bed; adding, in a note, that Professor Henslow had ascertained the existence of two other beds of dirt (or of clay with carbonaceous matter) below it; one of them about seven feet beneath, the other about two feet still lower down.

On visiting the Isle of Portland last summer, with a knowledge of these facts, I found that the clay, or 'dirt,' below the *Cap* (the upper apparently of the two additional clays described by Professor Henslow), itself contains Cycadeæ, in an upright position, and to all appearance in the places where they had grown; and I obtained also some new evidence respecting the character of the beds immediately above."

The bold eminences in the eastern part of Devonshire, called "Blackdown Hills," composed of green sand, are well-known from their furnishing both "whet stones" and "sithe stones,"

for which purpose several quarries are opened. We extract the following passages, describing the pits and process of manufacture:—

"The strata which afford the whetstones are about eighty feet below the top of the hill, to which they are parallel. The mines (or 'pits,' as they are called) are driven in direct lines into the hill almost horizontally, and in some cases to considerable distances. The stony masses from which the sithe stones are cut, are concretions of very irregular figure, imbedded in looser sand, nearly resembling those which occur in the upper division of the lower green-sand near Sandgate: and though very irregular in shape, marks of the stratification of the sand can be traced on their outside. The masses of which the sithe-stones are made, vary from six to about eighteen inches in diameter, and the beds which afford them would form a total thickness of about seven feet, of which about four are fit for that purpose; the looser stone at the top and bottom being employed for building."

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"*Sithe-stones.*—As the manufacture of these stones occupies a great number of the inhabitants of the country, and is of some commercial importance, a large proportion of the whole quantity used in England being supplied from the Blackdown pits, I shall here describe the method of preparing them.

"The sithe-stone men take from the owners of the soil the privilege of digging for stones, leaving forty yards on each side between the drifts (or 'pits,' as they are called). There is no limitation as to depth, and the drifts are commonly pushed to about 300 yards inwards, greater distances not repaying the labour of bringing out the sand. When first taken out, the stone is greenish and moist, and can be cut or chopped with ease. The tools employed are a sort of axe or adze with a short handle called a 'basing-hammer,' which is ground to a sharp edge. These are made at the adjacent village of Kentisbere. The other tools are 'picks,' without any peculiarity of structure, and 'hollowing-shovels' for digging the masses of stone out of the sand.

"For the purpose of cutting the stones, a vertical post of wood, or 'anvil,' is so fixed in the ground as to stand between the knees of the workman, who sits upon a sort of bench built of stone, with some strong pieces of old leather attached as a defence to his left knee. He first, with the edge of his 'basing-hammer,' splits from the blocks upon his knee, long portions approaching to the shape of the sithe-stones; and then cuts or chops them down nearly to the required size, upon the anvil and his knee,—just as a carpenter cuts timber with an adze. After being thus rudely shaped, the stones are 'hewn to the proper dimensions with a larger 'hammer,' and then rubbed down with water by women, on a large stone of the same kind; and when dried they are fit for sale.

"The stones when finished vary from about ten to twelve inches in length; some have the shape of a portion of an almond, with the ends and sides cut square, and about two inches by one and a half in thickness; others are almost cylindrical, but smaller at each end, with the sides a little curved; the diameter in the middle about two inches.

"A good workman can cut out of the blocks about seven dozen of the stones per day. They are sold by the makers chiefly to one merchant at Honiton, who supplies the retail dealers. The prices (in 1825) varied from 2s. per dozen for the finest stones, eleven to twelve inches long, down to 8d. a dozen for the coarsest, ten inches in length."

The beautifully preserved fossils of the Blackdown Hills are thus noticed—

"The great numbers and variety of the Blackdown fossils may be ascribed in part to the extent of the quarries, which have been dug for sithe-stones during a long series of years; but the beds themselves must be more than commonly fertile in these productions, since the entire thickness of those from which almost all the specimens have been obtained, does not exceed twenty feet. Their beautiful preservation arises in some measure, from the loose sandy character of the matrix in which they are imbedded, and from which they are easily detached; but the composition of the fossils themselves has also contributed to this effect; for, with very few exceptions, the shells are converted into chalcedony, and the whole of their calcareous matter has disappeared. This is the more remarkable, as in many other places, indeed generally, the fossils of the greensands consist of carbonate of lime; the absence of which, however, is prevalent throughout the sand of the Blackdown Hills, which seldom effervesces with acids: and to this circumstance, probably, the excellence of the concretions which they contain, as a material for whetstones, is to be attributed."

We extract the following account of the petrified trees occurring in the Portland strata:—

"I saw no traces of trees or Cycadeæ either at Chicksgrove or Wockley, nor could I learn that any specimens had been found there; but I had the satisfaction of finding, on the road from Totterdale towards Walmead, at a point nearly on a level with the top of the quarry at Wockley, several fragments of a silicified coniferous trunk, with cavities encrusted with quartz crystals, as in Portland and the Boulonnois, which had obviously come from a stone pit just then filled up, on the road side: and soon afterwards, the workman who had dug them out informed me, without being asked a question, that all the fragments were portions of one large mass, 'thicker than a man's thigh,' which, he said, stood upright among the strata, '*like a gatepost*,'—and did not lie flat like the beds of stone. He had quarried,' he said, 'many a piece near this place, as much as a man could heave up, and all standing upright.' This testimony leaves no doubt that trunks in the erect position have been found here,—precisely in the geological place where they might have been expected; and it is highly probable that further examination will lead to their discovery *in situ*."

The occurrence of the once valuable mineral, "fuller's earth," in the lower green end, is thus noticed:—

"One of the most remarkable subordinate beds of the formation in this neighbourhood, is Fuller's earth, which, when I was there (in 1824) was brought out by mining from the north-west escarpment of the sand-hills, near Hogstye-end, between the main road from Woburn to Northampton, and that from Hockliff to Stony Stratford."

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"The geological place of the Fuller's earth is here, therefore, nearly the same with that of Nutfield described above; which, however, is thicker than this of Bedfordshire, and is continued through a much larger space. I did not find here any of those nodules of sulphate of barytes, which are frequent in the earth of Nutfield; and in neither of these two situations, does this bed contain the great number and variety of fossils by which the Fuller's earth at the bottom of the lower green-sand is distinguished, at Atherfield in the Isle of Wight. In the sands of this part of Bedfordshire silicified coniferous wood is frequently found in large detached pieces.

"These pits have continued to supply Fuller's earth for more than a hundred years. They were described, in 1723, by Dr. Holloway, in a letter to the celebrated Woodward, which is remarkable in the earlier history of stratigraphical geology in England: the author, pointing out the parallelism of the range of sands, to that of the chalk in the Chiltern hills, and suggesting distinctly, upon geological grounds, the probability that other portions of the sand range would afford the same valuable material; which, we have seen, coincides with the result of modern investigaton."

We now proceed to extract some passages from the summary and general remarks, which form the concluding part of Dr. Fitton's paper, taking first the local thickness of the strata, as information on this subject is often extremely valuable:—

"*Thickness of Strata.*—I have not inserted in the engraved section the thickness of the groups; both because it varies much in different places, and that in general my estimates are so loose as not to be relied upon. Accurate measurements of the thickness of the English strata have very seldom been made. The following are approximate numbers, derived, however, principally, from estimates by the eye.

"*Chalk.*—The entire thickness of the chalk is exposed in many of the sections on the south-eastern coast; but westward of the Isle of Wight the beds are convergent and much reduced in bulk. Between Deal and Folkstone, Mr. W. Phillips has estimated the total thickness at 820 feet. The two sections at the extremities of the Isle of Wight, between Whitecliff and Sandown Bays on the east,—and between Alum Bay and Broadbench, at the western extremity of the central ridge, furnish good evidence; the strata being so nearly vertical, that the horizontal line across their direction, does not very much exceed the perpendicular to their surfaces. Mr. Greenough has accordingly estimated the thickness at Culver at 1300 feet; and the interval, on the Ordnance map, which is very nearly the same at the two extremities of the island (being in both places about two furlongs, or 1320 feet), may probably be considered as somewhat exceeding the maximum thickness of the chalk in England.

"Mr. Conybeare estimates the chalk as ranging between 600 and 1000 feet; and Mr. De la Beche at 700. The height of the cliff at Beachy Head, which includes at top part of the flinty chalk, and goes down very nearly to the upper green-sand, is only 535 feet; but if 250 feet be added for the remainder of the flinty chalk (350 being the thickness of that division near Dover), the aggregate thickness on the Sussex coast will be about 850 feet.

"At Wendover Hill, the summit employed as the ordnance station is 905 feet above the sea; and the canal at Wendover being at 404½ feet, and still within the chalk, the difference, 500 feet, is certainly less than the total thickness at that place.

"But the whole of the chalk passed through in the boring above-mentioned, at Diss in Norfolk (which includes at the top 100 feet without flints), was only 510 feet.

"The wide range of variation in thickness above stated (supposing the measures to be correct), arises in a great measure from the unequal abrasion and removal of the upper strata; but must in part also be ascribed to original inequality in the thickness of the chalk itself.

"*Upper-green-sand.*—The thickness of this group near Folkstone does not exceed thirty feet, and is probably much less; but it swells out considerably near Godstone, and Merstham, and at the latter place is upwards of thirty feet thick. The depth of the wells sunk through it, in the main rock strata of Hampshire, varies from sixty to 100 feet. In Western Sussex the thickness is between seventy and eighty feet; in the Isle of Wight, about seventy feet. At Blackdown the thickness of the sand is about 100 feet; in the vale of Wardour, probably from sixty to eighty; near Swindon, thirty to fifty feet: but at the Castle Hill, Cambridge, it is not more than eighteen inches. Thence through West Norfolk, the stratum is not anywhere distinctly seen; and at Hunstanton, the only beds which can be supposed to represent it, are not more than two feet thick.

"*Gault.*—The thickness of this stratum near Copt Point, derived from barometric measurement, is about 130 feet. In the interior it is difficult to obtain good estimates, and accurate measures can be expected only in wells. At Merstham it is 150 feet thick, in the Isle of Wight probably about 70 feet; at Ridge, in the Vale of Wardour, it is about 75 feet; at Cotmore Wells, near Thame, 90 feet. In Cambridgeshire the entire stratum has been cut through repeatedly in wells and borings, which give an average thickness of 150 feet; but at Mildenhall, in Suffolk, the blue clay, which seems to represent it, is only 9 feet. In West Norfolk Mr. Rose considers that the utmost thickness cannot be more than 15 feet; and at Hunstanton, the red marly beds which are supposed to contain gault fossils, are only 4 feet thick.

"*Lower Green-sand.*—The measured thickness of this formation can be most easily obtained on the shore between Copt Point and Hythe, where the uttermost subdivision is about 70 feet thick; the middle group 70 to 100 feet; and the lowest 60 to 80 feet; the total thickness, consequently, about 250 feet. In Western Sussex, Mr. Murchison states that nearly 400 feet of sand were passed through in a boring, at Petworth Summerhouse; and Mr. Martin conceives that the two lower members may be together about 150 feet thick. In the Isle of Wight the thickness, between Bonchurch Cove and Sandown, Rocken End and Atherfield Rocks, cannot be less than that of the formation near Folkstone, and seems to be much greater. At Brill, in Buckinghamshire, about 26 feet remain; in West Norfolk, Mr. Rose considers the thickness of the whole formation to be about 80 feet.

"*Wealden.*—No measures, on good estimates, of the thickness of the strata in this group have yet been obtained. Mr. Martin assigns 281 feet to the *Weald-clay*, cut through in boring, at Petworth in Western Sussex; but in the section at Tiepit and Cowleaze Chine, in the Isle of Wight, the clay seems to be no more than 140 feet thick.

"The section of that part of the *Hastings-sands* which is visible between St. Leonard's Church and the top of the great sand rock bed, may be about 200 to 250 feet; the sand rock bed itself, under the castle, about 80 to 120 feet; and thence to the lowest point upon the coast, east of Hastings, about 200 or 250—total thickness between 400 and 500 feet.

"It is difficult from their contortions, to estimate the thickness of the *Purbeck strata* on the coast. Mr. Webster has given in detail the stratification of a portion of them, which amounts to 124 feet eight inches; to which may be added about 150 feet,—making a total of about 275. In the vale of Wardour, the total remaining thickness of the group appears to be from forty to sixty feet, and in Buckinghamshire still less. Mr. De la Beche estimates the whole formation at 250 feet. The aggregate thickness, therefore, of the three groups which compose the Wealden, cannot, probably, be less than 800 feet.

"*Portland stone.*—This formation being well defined and fully exposed, its thickness is well ascertained; and in Portland Island it seems to range between sixty feet and about seventy; at Swinden it is about sixty to sixty-five; at Great Hazeley in Oxfordshire twenty-seven feet; at Brill, about twenty-three feet; near Quainton and Whitechurch in Buckinghamshire, from four to twenty feet.

"*Portland sand.*—Near St. Alban's Head, Isle of Purbeck, 120 to 140? feet; in the Isle of Portland, eighty feet; near Thame in Oxfordshire, about fifty feet.

"*Kimmeridge clay.*—The thickness of this group is uncertain, and seems to vary much in different places. On the coast Messrs. Buckland and De la Beche assign to it 600 feet, at Kimmeridge Bay; but they state the thickness at Ringstead Bay to be only 300 feet. At the Headington quarries in Oxfordshire, I found, in one of the pits, only twenty feet of clay. The general thickness is stated by Mr. De la Beche to be 500 feet.

"*Oxford oolite.*—On the coast near Weymouth, 150 feet. The whole in Wiltshire, according to Mr. Lonsdale, about 200 feet; Mr. De la Beche, 150 feet.

"*Oxford clay.*—On the Dorsetshire coast, near Weymouth, 300 feet; at Lynn in west Norfolk, Mr. Rose assigns to this formation the whole depth of a well, which would make the thickness about 630 feet; but part of this depth may possibly be Kimmeridge clay. Mr. De la Beche's estimate for the whole formation is 600 feet."

Our limits prevent further notice at present, but in the next Supplement we shall conclude Dr. Fitton's paper, and also notice the others, to which we have before alluded.

London and Edinburgh Philosophical Magazine and Journal of Science. No. 58; January, 1837.

The number of this work for the present month is now before us, and forms the beginning of the tenth volume of the third series. The "Philosophical Magazine" has been too long established, and is too well known to the scientific public, to require any lengthened notice; we shall, therefore, briefly glance at such of the papers as refer to subjects in which we are especially interested. Two articles of this kind are contained in the present number—"Observations on the Crag, and on the fallacies involved in the present system of Classification of Tertiary Deposits," by Mr. Charlesworth; and "Additional Remarks on Mr. Hopkins's researches in Physical Geology," by Dr. Boase.

The labours of Mr. Charlesworth are well known to have been chiefly directed to Tertiary Geology, the able exposition of his views on this subject laid before the British Association at their last meeting, was given at length in one of our early Supplements, and we may observe, that in the present paper (which is to be continued in future numbers), the same ideas are developed in a still more elaborate manner.

We extract the following passage, as briefly illustrating Mr. Charlesworth's views, and shall hereafter return to the continuation of his interesting paper:—

"Now, if we entirely throw aside all reference *to a per-centage of species*, and could substitute in its place a scale of degrees—still taking the existing forms as a standard to which the fossil ones are to be *referred*, but determining the amount of approximation by the *totality* of the characters which each series exhibits—we might then, perhaps, justly anticipate an agreement in the conclusions arrived at by different conchologists as to the relative age which should be assigned to any one fossiliferous deposit of the tertiary group—provided, of course, that there be no difference in their respective qualifications for conducting the necessary examination."

The valuable labours of Dr. Boase, are well known to have been chiefly directed to a field far removed from the one to which we have just alluded—that of primary geology. We extract from his paper the following brief summary of the points on which he is opposed to the opinions of Mr. Hopkins:—

"The point at issue between us is, as Mr. Hopkins has justly remarked 'whether the jointed structure of disturbed masses has been in great measure superinduced *previously* or *subsequently* to their elevation.' Two other topics have been dwelt on in his reply—the nature of the elevatory force, and the origin of veins—both very interesting, but not, I conceive, so easily determined by *observation*, as the question more immediately under discussion.

"Mr. Hopkins asserts, 'that it is totally inadmissible to assume the earth's crust to have become jointed, before the action of the dislocating force upon it.' I, on the other hand, contend that *solid* rocks not only existed *previously* to their having experienced elevatory movements, but also that such rocks must necessarily have had a *jointed structure*. This is, I think, a fair and plain statement of the case *sub judice*, divested of all its collateral intricacies."

We may observe that several excellent papers on various departments of science—mathematical, chemical, and physiological, together with the proceedings of the Royal Society, &c., make up the contents of the present number of the "Philosophical Magazine."

The Railway Magazine, and Annals of Science. New Series. January, 1837.

The number of this publication for January is now before us, and contains its usual proportion of scientific and practical articles, interesting to the engineer and the railway speculator. Did space allow, we should make some extracts from a "Lecture on Railroads," commenced in the present number, but we must limit our quotation to a short but very sensible article on the "Utility of Aerostation," by the Editor. The impossibility of effectually managing and guiding balloons, is but too apparent, notwithstanding the late extraordinary achievement; yet we are unwilling to relinquish all hopes of applying this invention to purposes of utility. The suggestions of Mr. Herapath on this subject are well deserving of attention, and should they be carried into effect, we are induced to anticipate results of interest and importance, probably the only ones which the balloon will ever be capable of affording.

"Mr. Mason, who accompanied Mr. Green in his late balloon excursion into Germany, has just published a detailed account of the aerial voyage, which strongly corroborates my former observations on the hopelessness of guiding balloons through the air. Animated and interested as the picture is which Mr. Mason has drawn of the voyage, one cannot but see utter inutility standing prominently forward in every page that he has written.

"What does the whole account prove beyond the simple facts known to every schoolboy, that by throwing out ballast the balloon's buoyancy is increased, and it ascends; on the contrary, by letting off the gas the buoyancy diminishes and the balloon consequently descends? As to guidance—the voyagers prudently resigned that to the caprice of currents they could neither coax nor command to their purpose, and therefore the less said on this subject doubtless it was thought the better.

"But though the probability of directing balloons is desperate, still they may be turned to useful account in the hands of men of science. For example, we know but little experimentally of atmospheric currents, of the nature and formation of clouds, the rates of decrease of temperature, pressure, and humidity in the more open and elevated regions of the atmosphere. Now such experienced aeronauts as Mr. Green and Mr. Graham, aided by men of science with competent instruments, might soon extend our knowledge of these subjects, and convert an instrument of fruitless curiosity into one of real and substantial utility.

"Meteorology for instance, is a branch of science, the least perhaps of any understood. By means of a balloon, however, we may visit nature in every corner of her laboratory, witness her operations, and record them from personal inspection. If then it be true, as many able philosophers think, that the now uncertain winds and wandering clouds, are caused and regulated by fixed and steady laws, we shall be in the fairest way to discover them. But suppose we could even attain such knowledge approximately, of what immeasurable advantage would it be to society! Who could calculate the benefits a pre-knowledge of the weather would confer on the farmer, or of the winds on the mariner, and, by our natural relations on us all? Could we but have foreseen the late hurricane only for a single week, how much property might have been saved, and how many valuable lives to their respective families might have been preserved!

"Again, we can scarcely open any of our books of astronomy, but we find them teeming with complaints of the imperfection of our theories of refraction, and all owing to the want of better acquaintance with the two or three elements I have named above. Now every man knows that accurate tables of refraction are the corner-stone of astronomy. Improve the one, and you necessarily improve the other, and by consequence navigation. From navigation the benefits spread immediately over commerce.

"Thus might a machine, which is now a mere isolated and barren toy, be converted to the most important and valuable purposes.

"But by extending our knowledge in the above cases, we may indirectly accomplish the very object the balloon goers are now seeking, namely, the making of it a travelling machine. For should we discover any constant or periodical currents in the lofty regions of the air with their limits of action, though we never could hope to oppose them, we may ascend or descend to them, and avail ourselves of their assistance to reach our destination pretty nearly, as ships now do with the trade and other winds."

Bentley's Miscellany. Edited by "Boz:" with Illustrations by George Cruikshank. No. I.; January, 1837. Bentley, New Burlington-street.

We are free to confess the work before us does not properly fall within our province, but we plead in extenuation of our notice, a desire to introduce to our readers a pleasant and humorous companion at the commencement of the new year. There is furthermore a certain poetical effusion in the "Miscellany," which we consider so appropriate to our pages, that at first sight we determined to transfer it thither—we allude to the "Anti Dry-Rot Company's Song," in which the praises of the ingenious Mr. Kyan are "married to immortal verse," and the merits of his invention set forth in such glowing terms, that we think Mr. George Robins, were he "instructed to sell the *patent* at the Auction Mart," would be much puzzled to surpass them.

It is pleasing to remark how rapidly "utilitarian" principles are making their way in the present age of steam and railroads, to see the Muses employed in so useful a vocation as the praises of "Kyan's Patent"—that invaluable composition, which is destined to save future generations the expense of ship-building, to banish the dry-rot from our houses, to make "whims," "capstans," and "shears" immortal, and to prevent the finger of decay from being laid on "stulls," "timbering," and "pump-rods," to the great benefit and advantage of the mining interest. True it is, we have been for some time verging towards the point, at which we have now arrived, as is ably described in the introduction to the article to which we have alluded. It is well known that one of the Muses has long been in the service of Mr. Warren, the celebrated blacking-manufacturer; and even the aristocratic spirit of Byron did not disdain to pay a well-merited tribute of respect to the results of Mr. Rowland's science and philanthropy, in those felicitous, and doubtless much-admired, lines—

"In virtues, nothing earthly could surpass her
Save, Rowland, thine incomparable oil, Macassar."

We must confess, however, that all the utilitarian flights of the Muse that we have yet seen, fall far short of the "Anti Dry-Rot Company's Song," which we now present to our readers, recommending to them, at the same time, a perusal of the "Miscellany," in which our friend "Boz" (of the "Pickwick Club") now first appears in his new and Editorial capacity, assisted by several well-known writers, of considerable humour and ability.

"Have you heard—have you heard—
Anti dry-rot's the word?
Wood will never wear out, thanks to Kyan, to Kyan!
He dips in a tank,
Any rafter or plank—
And makes it immortal as Dian, as Dian!
If you steep but a thread,
It will hang by the head,
For ever, the largest old lion, old lion;
Or will cord up the trunk
Of an elephant drunk;
If you doubt it—yourself go and try 'un, and try 'un.

In the days that are gone,
As to timber and stone,
Decay was by no means a sly 'un, a sly 'un,
He bolted our floors,
And our vessels by scores,
And the thirsty old rot was a dry 'un, a dry 'un!
Oak crumbled beneath
The dry blast of its breath,
As soon as it e'er came a-nigh 'un, a-nigh 'un;
But gone is the day,
Of that glutton Decay,
Since he can't eat his timber with Kyan, with Kyan!

Say—now—what shall we steep
In the tank? just to keep.
Shakespeare sniffed our great secret, the sly 'un, the sly 'un!
Hamlet, Macbeth, and Lear,
Have been Kyan'd, my dear,
By Nature's immortal Paul Pry 'un, Paul Pry 'un.
Shall the plays of the day
Take a plunge from decay?
(There is no need for Tell, or for Ion, for Ion;)
I fear he could not
Soak away the dry-rot
From *some* things—but *all* rests on Kyan, on Kyan.

Put the lid on the tank—
Not a crack for a plank—
While I point out one thing, as I fly on, I fly on,
Which really must not
Have a dip 'gainst dry-rot—
Stuff with cotton the ears of my Kyan, my Kyan.
In a whisper I speak,
(But 'twill rain for a week—
Or as long as St. Swithin will cry on, will cry on—)
The moment I make
Your conviction awake
That *Vauxhall* wants no plunge 'gainst the dry 'un, the dry 'un.

Do not dip many books
In our anti-rot nooks;
Keep out novels, and all Sense cries Fie on! cries Fie on!
Though, since Wood turns sublime
In its strife against time,
Most heads that we know, will try Kyan, try Kyan.
Only think what great good
'Twould do Alderman Wood,
(Elected for life) if they'd try 'un, they'd try 'un;—
Every word that I say
Is as true as the day,
And each hint you may safely rely on, rely on!

Then, hurrah! come uncork!
This dry-rot is dry work;
Bring the bottle—that one I've my eye on, my eye on;
My spirit I'd steep
In its rich *anti-deep*,
And linger for morn, like Orion, Orion!
'Gad the secret is out,
We've talk'd so much about;
My dog's on the scent—oh! then hie on, then hie on!
'Tis the *bottle*, I feel,
Makes immortal mere deal,
And wine's the *solution of Kyan*, of Kyan!"

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. IV.

In the following extract the general nature and objects of geological science are well explained; we conceive, therefore, it may be acceptable to many of our readers, more especially as it defines with great precision the respective limits of *Geognosy* and *Geology*, terms generally used as synonymous by English writers. The greater propriety and correctness of the former term, now generally adopted on the continent, must at once be admitted; the substitution is not, however, of a very important nature, and the term Geology, in its widest sense, has been so generally used, and is so well understood in this country, that any alteration would now be a needless piece of refinement, and by no means unattended with inconvenience.

GENERAL VIEW OF GEOGNOSY.

The object of geognosy is the knowledge of the mineral masses, or rather of the various groups or systems of mineral masses forming the solid portion of the terrestrial globe. This science brings under our review the mineralogical composition, structure, form, and extent of each of these systems—their reciprocal relations—the circumstances of their superposition—all that relates to the manner and period of their formation—the changes or degradations through which they have passed; and, in short, whatever relates to their natural history; and as our globe is wholly composed of these combinations, an acquaintance with its constitution, physical as well as mineral, is the final result proposed by this science. Its researches, however, are limited to a very thin crust of the globe, being less than the thousandth part of its semi-diameter, reckoning from the highest elevation reached by man, being that attained by Humboldt on Chimboraço, in Peru, or 19,350 feet, to the greatest depth supposed to have been reached, namely, 1300 feet below the level of the ocean; all beyond this is out of the reach of human investigation.

The term geognosy, derived from γῆ (the earth), and γνῶσις (knowledge), simply signifies "the knowledge of the earth;" an idea formerly expressed by the word geology, from γῆ and λόγος (a discourse); but as the word λόγος has a wider and more vague acceptation than γνῶσις, and as, in fact, the geology of that period comprised merely a series of dissertations and theories on the formation of the earth, a more definite term has been applied in Germany and France, and is now generally adopted by the learned of those countries.

Werner, moreover, remarks, that the words composed of λόγος, such as zoology, mineralogy, &c., denote the totality of our knowledge of a subject; and accordingly geology, in this view, comprises not only geognosy, but also geography, hydrography, and geogeny. Geognosy is, therefore, distinct from the various systems of geogeny, although it should comprehend all the facts which the globe offers to our observation, and from which deductions may be made in reference to geogeny.

Let us now briefly pass in review the objects to which geognosy limits our attention, and these are—

1. The figure of the terrestrial globe.
2. The fluids surrounding it.
3. The inequalities of the surface.
4. The agents which act on that surface, and the degradations or changes resulting from such action.
5. The structure and superposition of mineral masses.
6. The changes progressively produced in their formation.
7. The nature and peculiarities of mineral deposits.

We shall now introduce a few observations on each of these points. In respect to the figure of the globe, we find it to be exactly such as a fluid mass must take, if under the influence of a similar motion; this leads to the conviction of its primitive fluidity; and the investigation of its various phenomena leads us to think that this fluidity must have extended to the interior, and have formed a mass near its centre of nearly equal distribution. These are the only ideas we can hope to acquire on the interior of the globe.

We next behold the solid mass of the earth, partly covered with an aqueous fluid, and entirely surrounded by an atmospheric envelope: the waters rise in the form of vapour, producing clouds and rain and dew; and if we then consider the inequalities of all parts of the earth, we shall have to bring under observation either continents rising above the general water level, or the ocean-bed sinking below it—immense plains or mountainous regions; and here the shattered appearance which these inequalities present; the quantity of pebbles, gravel, and sand arising from the destruction of rocks, prove that the crust of the globe and the masses composing it, have experienced considerable degradations and changes since the period of their formation. We find this unequal surface continually acted upon by aeriform and aqueous fluids, decomposing the hardest rocks; and we also detect agents of another class, subterraneous fires, and the fluids and gases to which they impart so terrible a force. At one time these perforate the crust of the globe and form volcanoes; at another, the same agents pent up in subterranean cavities, shake the surface by their escape, and produce the phenomena of earthquakes, fissures, clefts, and sometimes depressions of the surface.

When the geognost, after studying the nature of the surface, descends into the interior of the globe, he finds a variety of mineral substances, appearing at first as if thrown together in a confused manner; but on a closer inspection he finds this disorder to be only apparent, and he soon distinguishes the regular succession of rocks, primary, stratified or unstratified, and of different formations, evidently at distinct epochs, forming together the mineral crust of the globe.

The next object of attention is the prodigious quantity of animal and vegetable remains occurring in the masses above noticed, indicating the order of succession in which organised beings have existed. Vestiges of animals, capable of existing only in the depth of the ocean, are discovered imbedded in rocks on the summit of mountains; the bones of others, natives only of the torrid zone, appear buried in the frozen soil of the polar regions; and in almost every situation animal and vegetable substances present themselves, totally differing from any of those at present known, and, as it were, transporting the observer into a new world. Every thing proves that important changes and revolutions have taken place. Marine shells, reposing in beds in the midst of mountain ridges, are an irrefragable evidence that anciently the ocean rolled over our continents, and that the animals once inhabiting these shells had an origin antecedent to that of the mineral masses in which they are inclosed—an additional proof that the latter were not always in a state of solidity. The figure of the earth, the sedimentary nature of successive strata, the crystalline structure of most minerals, lead to a similar deduction, and force the conviction on the mind that these rocks, beds, and minerals were once either fluid or suspended in a fluid; and owe their present peculiarities to successive deposits, each bed being distinct from the others, so that the lowest must be considered the most ancient, especially since they contain no vestiges of organic life, and consequently lay claim to priority of existence, being in fact designated primary rocks. The next, or secondary, contain vast quantities of the wrecks of animals and vegetables, and other substances formed from the fragments of the primary rocks. Between these two appears the intermediary formations, retaining certain traces of the latter, and yet exhibiting the first traces of organic matter. Nearer the surface we find the alluvial deposits; the detritus of rocks composing vast incoherent strata of earthy matter, gravel, sand, &c.

Lastly, the volcanic regions will demand attention—covered with ejected matter, and frequently intermingled with the secondary formations. After this general survey, the scientific observer will proceed to the details relating to each of these formations—investigating their mineral treasures, noticing the form, extent, and other circumstances of their stratification, superposition, &c.; carefully examining their beds, veins, branches, and the proportions of their metallic to their other component parts, and to the rocks inclosing them.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—Wednesday, Jan. 18.

Mr. Lyell, President, in the Chair.

Several communications were read.

1. An account, by Mr. Bowerbank, of a deposit containing recent land shells, at Gore Cliff, in the Isle of Wight. The cliff consists of the upper green-sand, capped with chalk marl, on which rests the bed containing the recent shells. It consists of detritus of chalk and chalk marl, is ten feet thick, and ranges to the foot of St. Catherine's Down, a distance of about 660 yards. The shells are dispersed through every part of the bed, and belong entirely to well-known recent species. Similar deposits were observed by Mr. Bowerbank near St. Lawrence, and between Ventnor and Bonchurch.

2. A letter from Mr. Wyatt to Dr. Buckland, on a trap-dyke in the Penrhyn slate-quarries, near Bangor. A few months since, in carrying on the highest opening in the quarry, the men came suddenly in contact with the trap. The width of the dyke is eleven feet; its direction apparently between west-north-west and north-west, and it intersects the strata nearly at right angles. The slate immediately in contact with it is in some places highly indurated, having lost its fossil character, and the colour is changed from purple to black, but at the distance of two or three feet, the slate recovers its usual colour and fossile structure.

3. A notice, by Mr. Richardson, of a successful boring for water at Mortlake, in Surrey. The point at which this undertaking was commenced is within 100 feet of the Thames, and on the property of Mr. John Randell. In the first instance, an auger, seven inches in diameter, was used in penetrating twenty feet of superficial detritus, and two hundred feet of London clay. An iron tube, eight inches in diameter, was then driven into the opening to dam out the land springs and the percolation from the river. A four-inch auger was next introduced through the iron tube, and the boring was continued until the clay having been perforated to the depth of 240 feet, the sands of the plastic clay were reached, and water of the softest and purest nature was obtained; but the supply was not sufficient, and it did not reach the surface. The work was proceeded with accordingly, and after fifty-five feet of alternating beds of sand and clay had been penetrated, the chalk was touched upon. A second tube, four inches and a half in diameter, was then driven into the chalk, to stop out the water of the plastic sands, and through this tube an auger, three inches and a half in diameter, was introduced, and worked through thirty-five feet of hard chalk, abounding with flints. To this succeeded a bed of soft chalk, into which the instrument suddenly penetrated to the depth of fifteen feet. On the auger being withdrawn, water gradually rose to the surface and overflowed. The expense of the work did not exceed 300*l*. The general summary of the strata penetrated is as follows:—Gravel, 20 feet; London clay, 240; plastic sands and clays, 55; hard chalk with flints, 35; soft chalk, 15=365 feet.

4. A paper on the strata usually termed Plastic Clay, by Mr. John Morris. After alluding to the description of the Paris Basin, by Cuvier and Brongniart, and to the memoirs of Mr. Webster, Dr. Buckland, Mr. Richardson, and Mr. Rofe, on the strata immediately above the chalk in England, the author proceeded to detail the results of his own observations on the lower portion of the same beds. He divided them into three groups, (*a*) the oytser beds, (*b*) the Woolwich and Upnor strata; and (*c*) the lower arenaceous beds of the London clay.

(*a*). The oyster beds, well known at Reading, rest upon the chalk, and consist of green or grey sands, containing great abundance of a large species of oyster. The localities at which they have been examined by Mr. Morris, are Hertford, Northam, and Hadley.

(*b*). The Woolwich and Upnor strata consist chiefly of clay, sand, pebbles, and a calcareous rock, and are distinguished by containing fresh-water, estuary, and marine shells. In the local distribution of these remains the author has noticed considerable differences; thus, at Woolwich pits the greater number of the shells are fresh-water, while at Plumstead and Upnor, near Rochester, marine remains prevail. The principal localities mentioned in the paper are Woolwich, Sundridge Park (near Bromley), Chislehurst, Orpington, Beckenham, Sydenham, Counter-hill (between New Cross and Lewisham), Bexley-heath, Erith ballast-pit, Green-street (near Stoke), and Upnor. They are said to occur also at Stifford and Plaistow, in Essex. The thickness of the beds varies greatly, even within a few yards, and the order of their succession differs in every pit. The following is the section presented by the opening on Bexley-heath:—Vegetable mould and gravel, two feet; sand and pebbles, six inches; ferruginous sand, three feet; mottled clay, two feet; crown clay, with shells, one foot; blue, slaty clay, lower part sandy, two feet; loam, with numerous shells, three feet; ferruginous sand, depth unknown.

(*c*.) The lower arenaceous beds of the London clay consist of grey or green with calcareous sandstone, and have been long known for containing at Bognor great abundance of shells which belong to marine genera. The localities mentioned by Mr. Morice are numerous, but those which have produced the greatest number of fossils are, Bognor, Herne Bay, Pegwell Bay, Alum Bay, Binfield, Bray Hampstead (in sinking a well), and Faversham. He is also of opinion that the sandy limestone of Llancourt in France is of the same age.

5. A memoir on the geology of Suffolk by the Rev. W. B. Clarke was commenced. The portions which were read, described the physical features, the drainage of the county, the chalk and the plastic clay. As we shall have occasion to notice this memoir when the remainder has been read, we shall defer, till then, our analysis of the part brought forward on Wednesday evening.

ROYAL GEOGRAPHICAL SOCIETY.—Monday Jan. 9.

Sir John Barrow, Bart., President, in the chair.

Several presents were announced and members elected, amongst whom were Lieutenants Gray and Lushington, who are about to proceed, on a voyage of discovery, to Australia.

Captain Washington, the Secretary, read a letter from Captain Alexander, dated 17th September, in which he detailed the progress of his route from Cape Town to the Damparras country, where he had halted, twenty miles above the last missionary station, accompanied by three white and three coloured attendants.

A letter was also read from Vice-Consul Wilcher at Mogadore, dated 22d September, which announced that Mr. Davidson had started on his route, and promising to communicate any letters as soon as they should arrive, and complimenting the Sheick Beyrouck for the assistance offered to him.

An interesting communication was read from the Swan River, addressed to Major Irwin, giving information of the discovery of an extensive nation of natives in the interior, several of whom had spoken of and confirmed the existence of a great inland sea—an opinion which had been embraced by Drummond and other travellers. The waves were described as being very high, and their ideas of its magnitude was that it would take the compass of any man's life to make the circuit, as provided a child were to start from any point he would be an old man when he arrived there again. Sir John Barrow likewise announced that the funds had been provided by the Admiralty for the expedition of Lieutenants Gray and Lushington, who would shortly proceed in the ship of war destined for that station, on a surveying expedition, and that they might start to any point they deemed fit, their principal object being directed towards this inland sea, which, to the discredit of this country, had hitherto remained unknown.

The following interesting paper was read from Lieutenant W. Smith, of the 48th regiment, descriptive of an Ascent of Mount Athos, and a visit to its Mountains:—

"On the south-eastern shore of the districts of Saloniki, three remarkable peninsulas twenty-five miles in length, by about five in breadth, project, nearly parallel to each other, in a south-easterly direction, into the Archipelago, embracing the two gulphs of Monte Santo and Cassandra, or the Singitic and Toronaic gulphs of the ancients. The easternmost of these three promontories, better known by the name of Acte or Mount Athos—the Agion Oros of Modern Greeks, and Monte Santo of the Franks, is joined to the main land by a low sandy isthmus, about five miles long by nearly one and a half broad; and through which the famous canal was cut by Xerxes, slight traces of which yet remain. Immediately at the commencement of the peninsular, Mount Athos may be said to begin by an abrupt ascent of 200 feet, and from this to the town of Kares, about the centre of the peninsula, the height may vary from 950 to 800 feet; yet with one or two exceptions, may be termed a table land, intersected by many deep ravines, and, when the soil will support it, richly and beautifully wooded, chiefly with oak and chesnut. From Kares the land rises more rapidly, still rocky, broken, and well wooded, till you approach the great peak which shoots up in solitary magnificence, forming a barren cave of white limestone rising to the height of 6350 feet above the sea; close to the cliffs at the southern end, we learn from Captain Copeland's late survey, no bottom was found with sixty fathoms of line. The road by which Mount Athos is ascended, is only practicable two thirds of the distance for mules; from the monastery of Lavra on the eastern shore, the path winds round the southern extremity of the Cape, at about 600 feet above the sea, and gradually turns round the mountain, so that the chief ascent is made from the north-west. The ascent is very difficult, and occasionally perilous, and occupies five and a half hours, but the boundless view from the summit amply repays the fatigue; 'at our feet the islands of Lemnos, of Thaso and Samothraki: to the north the coast and mountains of Thrace and Macedonia, linked with all the associations of by-gone times; while, turning to the west, the mountains of Olympus, and Pelion, and Ossa, in Thessaly, revived all our classical recollections.' The peninsula of Mount Athos contains twenty monasteries, besides villages and cells inhabited by Caloyers. The two chief monasteries are inhabited by 120 persons, besides fifty mendicants attached to them; the whole twenty contain about 1500 men, including 300 mendicants: this is far from being a full number, as they have not yet recovered the effects of the Greek revolution, at which time the monasteries were occupied by Turkish soldiers, and the monks fled. At the village of Kares, a weekly fair or market is held, which presents the uncommon scene of a fair without noise, and a crowd without a woman; no female is on any account admitted within the precints of the mount, nor indeed anything, it is said, of the feminine gender."

The conclusion of the communication of Mr. Hamilton on Asia Minor was also read. The deficiency of a correct map of this country was much regretted, on account of the great number of mistakes in the situation of places which all at present in existence contain, and stating the interesting fact that every facility is given to travelling, the impediments and obstructions formerly supposed to exist being now entirely removed.

SOCIETY OF BRITISH ARCHITECTS.—Tuesday, Jan. 10.

This Society held a meeting at their apartments in Lincoln's-inn-fields. Mr. Alfred Beaumont read a paper on the best mode of warming buildings. The first requisite was a complete combustion of the fuel; the second, a complete delivery of the heat evolved in the place intended to be warmed. Nothing could be more wasteful of fuel than common open fires. Only one part in fifty radiated into the room; the great body of heat went with the draft of the chimney to the sky. If a kettle of water be placed before the fire it will not boil in twenty-four hours—placed over the fire it boils in half an hour. If a man stands in front of the fire he gets half-an-half warmed, the half next the fire is warmed, while the half away from it is chilled; but if he were to place himself in the line of the draft over the fire, he would soon be burnt to a cinder all round. The ancient Romans understood these things better than the moderns: they carried their flues horizontally under the pavement of the chamber to be heated. A stove on the same principle was erected at the County Fire-office ten years ago with perfect success. He had erected similar stoves at the elephant-house in the Regent's-park, at Sudbury-grove, at St. James's church, and other places, with similar success. These simple contrivances produce a saving of 11-12ths of the fuel consumed to obtain the same warmth by hot-air and hot-water stoves, and with perfect freedom from dirt, dust, smoke, and impurity of every kind. He was sure they only required to be more known to be adopted in all churches and chapels throughout England.

Glass.—Professor Florio, of Turin, has succeeded in giving greater durability to window glass, by adding lime water during its manufacture, by which means a silicate of lime is formed. The furnace in which it is melted requires a peculiar graduation, or the sheets will warp.

Diamonds of the Ural.—M. Paravey informs us, that various Chinese notices concerning natural history contain a great many facts, which are recent discoveries with modern *savans*; for instance, the existence of gold and diamonds in the Ural chain, and fossil ivory in Siberia. —*Athenæum.*

ON THE METALLURGIC TREATMENT OF GALENA AT BLEYBERG IN CARINTHIA.

By M. Boulanger, Engineer of Mines.

From Ann. des Mines, 3rd Serie, T. VII.

A very simple and commodious method of treating galena, is pursued at Bleyberg, in Carinthia, the theory of which process forms an interesting subject of enquiry, and it was this which induced me to make the following analysis of the products of the various operations pursued at these works. I shall first, however, give a short description of the operations, extracted from the journal of a tour made in this country in 1832-3, by MM. Gruner Harlé and Foy.

The mineral employed at Bleyberg is galena, found in veins in limestone, of which two kinds are chiefly worked; in one of the beds the galena is accompanied by pyrites and blende, with traces of silver; the other contains pyrites likewise, but rarely blende, and encloses sulphate of barytes and molybdate of lead without a trace of silver.

The two ores are dressed with much care, and mingled in such proportions as to be of good quality; for in order to be worked to advantage, they ought to yield sixty-five or seventy per cent. in a small assay. When prepared for smelting, they contain a little pyrites, blende, sulphate of barytes, and limestone.

The operations are conducted in a reverberatory furnace, eleven feet long, and four and a half broad, parallel to the longer side of which is the fire place. The bottom is inclined at an angle of 25°; the fire place, formed of brick arches, at about 46°. The flame and smoke escape through the chimney, situated at the side of the charging hole. The bottom is formed of clay, old bottoms and refuse pounded together in a dry state; it is slightly cylindrical in its whole length forming a kind of trough in which the lead flows.

When the bottom is well beaten, it is fired for five or six days, the heat being increased towards the last, to soften it, and it is then smoothed.

Each operation for the reduction of the galena consists of three parts; first, roasting; second, raking; third, the operation termed "pressen," in which the lead is acted upon by air and charcoal.

1. *Roasting.*—The furnace is charged with three quintals, twenty pounds* of the washed ore of two different sizes and qualities, the mean product of which should be at least seventy per cent. lead. When the foregoing operation is complete, the furnace is suffered to cool for a quarter of an hour, and then charged with the ore, which is spread uniformly by an iron rake. The heat is maintained at incipient redness to avoid the fusion of the sulphuret, and ought to be lower, in proportion to the purity of the material, because its tendency to fuse is diminished by the infusible nature of the matrix. It is stirred up every half hour by an iron rod, the handle of which rests on a hook suspended by a chain; not, however, too frequently, for that would retard the roasting.

This first operation lasts from four to five hours, during which the temperature is gradually raised, and that without inconvenience, since the fusibility of the material diminishes in proportion to its oxidation; besides which an elevation of temperature causes a re-action, producing lead which often begins to flow out in a couple of hours. The heat ought not, however, to be carried so far, that the lead comes red from the furnace. This is called virgin lead, and is received into an iron vessel placed beneath the charging hole.

2. *Raking or Stirring.*—While the roasting is going forward, the fire is increased to cause a more energetic re-action of the materials, causing the lead to flow abundantly. The workman frequently stirs the mineral by spreading it out, and again bringing it into a heap, and at length pushes it down to the bottom of the furnace, where the heat is more intense, at the same time surrounding the charging hole with blazing wood. This second part gives with the first, two-thirds of the lead, and when, notwithstanding the *stirring*, the lead ceases to run, the next operation follows.

3. The "*Pressen*" is only performed every second smelting, because it produces but little lead and requires much fuel, besides which, the ore is diminished in bulk. When the second operation is completed, the refuse called the rich scrapings *(krätze)*, is taken out; fresh ore is added and treated like the first; the first refuse is then added to the last, they are spread over the bottom of the furnace, and several shovels of live coals taken from the fire place, scattered over it. The workman mixes the whole by means of the iron rake, pushes it to the bottom of the furnace, increases the fire and stops the charging hole with blazing faggots. The lead flows out, and upon its ceasing, the workman again spreads out the pile for roasting, after which he adds more charcoal and brings the whole again into a heap. This alternate oxidation and reduction is continued till there are no longer traces of lead.

This operation lasts three hours, and when completed, the residue, termed the "poor scrapings," is taken out, and the bottom beaten to prepare it for another charge. The poor residues are stamped, washed and mingled with the ore.

One "*poste,*" composed of two charges, lasts twenty-one hours, during which one and the same workman, performs all the labour, who afterwards rests for two "*postes.*" Each poste gives from four quintal forty pounds, to four quintal sixty pounds of lead.

We now pass over to the examination of the products of these operations. The roasted ore taken out of the furnace before being stirred, is composed of a slightly caked, sandy mass, showing only a fusion of the lead, when subjected to a high heat in an earthen crucible. With black flux it gave fifty per cent. metallic lead, which gave no trace of silver by cupellation. This substance is very heterogeneous, presenting oxides, unchanged galena, and metallic lead, the greater part of which may be separated by stamping and sifting. The powder thus obtained, was boiled with water, which dissolved sulphuric acid, lime, and oxide of lead; the lime was present in larger quantity than was necessary for saturating the sulphuric acid, and to this excess was probably owing the solution of lead with sulphuric acid. But did sulphate of lime pre-exist in the mass, or was it not rather afterwards generated by the action of water? In order to ascertain this, I boiled water with a mixture of sulphate of lead and caustic lime, and found that all the acid was dissolved, together with a certain quantity of lead, which varied with the quantity of lime and water employed. The acid might, therefore, have existed in the state of sulphate of lead, and only combined with lime through the interposition of water; but since the sulphate of lime is more fixed than that of lead, the same might have occurred in the dry way, and the salt of lime have been formed in this case likewise; it is hence impossible to say in what state of combination the sulphuric acid existed.

Boiling acetic acid extracted from the remainder, insoluble in water, lime, oxide of lead, and protoxide of iron.

From this remainder, hydrochloric acid disengaged sulphuretted hydrogen. Having ascertained that silica was dissolved, which would be in a gelatinous state, I thought it advisable to extract this by means of liquid potassa, before the use of hydrochloric acid; the decomposition of the sulphurets might be apprehended by this means, and possibly a small portion of oxide of lead, found in solution in the potassa, arose from decomposed sulphuret, for an excess of sulphur was found by analysis; but without doubt the greater part of the oxide pre-existed in the substance in the state of *oxi-sulphuret*, and could not be taken up by the acetic acid.

The residue insoluble in potassa was treated with hydrochloric acid, and the liberated sulphuretted hydrogen received into ammoniacal nitrate of copper; an analysis of the resulting sulphuret gave the quantity of sulphur contained in the metallic sulphurets; the hydrochloric solution contained iron, zinc, and lead.

The residue insoluble in the hydrochloric acid contained a little lead, which was taken up by weak nitric acid, and added to that obtained by sifting. Lastly, roasting the last residue gave a little sulphur from its loss of weight, and there remained only sulphate of barytes, as was ascertained by an analysis with carbonate of potassa in a silver crucible.

According to this analysis, the roasted ore is composed of—

Oxide of lead	0.310
Sulphuric acid	0.023
Lime	0.042
Oxide of iron	0.004
Sulphuret of lead	0.225
,, iron	0.022
,, zinc	0.069
Sulphur	0.002
Silica	0.016
Sulphate of barytes	0.034
Metallic lead	0.233
	0.980

* The quintal is 221lbs. avoirdupois, English, and the French lb. about 2 lb. 3oz.

It follows from this analysis, that the roasted ore is principally composed of metallic lead, its sulphuret and oxide; for even supposing all the sulphuric acid to be in the state of sulphate of lead, still there would be but eight per cent. of it; now the roasting process, in heaps, generally gives a larger quantity of this sulphate; it is the more remarkable that the roasting in a reverberatory furnace gives rise to so small an amount, because it is performed in this case at a very low temperature, exposed to a current of air that ought to be highly oxidizing; in fact, the very inclined position of the fire place creates a current of air, which mingles with the flame above the ore, independently of the one below it; besides, in order to enter the furnace, the flame is obliged to pass through an opening only four inches in height (an arrangement analogous to the smoke-consuming furnaces of M. Lefroy), necessarily causing an eddy and a consequent mixture of the air and combustible gases, which ought to deprive the latter of every deoxidizing property; notwithstanding these circumstances, so favourable to the production of a sulphate, but little is formed. It appears to me explicable in the following manner.

The first effect of the roasting is to produce oxide of lead, which tends to unite with the sulphuric acid generated; the production of this sulphate ought therefore to be in proportion to the quantity of free oxide; now in a reverberatory furnace, the oxidation takes place superficially, and the oxide is in contact with the unchanged sulphuret beneath it; a re-action occurs, with the consequent production of metallic lead, while very little oxide is formed; it is hence easy to perceive that too frequent raking would produce a large quantity of oxide, part of which would be converted into sulphate, because the re-action could no longer as easily occur; and we have seen that at Bleyberg, the surface is renewed every half hour.

In roasting in heaps, the ore is put in layers alternating with charcoal, where re-action would only take place between the substances in the same layer, but as all are equally exposed to the oxidising current, they are soon roasted in an equable manner, and the production of sulphate ought consequently to be considerable. In fact, by comparing the quantity of sulphate produced by roasting the same ore in heaps, or in a reverberatory furnace, we shall find these suppositions verified; at Holzapfel, for instance, roasting in heaps produces nineteen per cent. of sulphate, in a reverberatory eight per cent.; at Pezy, in the one case, sixty-five per cent. of sulphate is obtained, while the other operation produces none. Roasting in reverberating furnaces offers, therefore, great advantages, since it generates the least possible amount of sulphate.

By exposing the roasted ore to a strong heat, a re-action is caused between the oxide and the sulphuret, with the production of a fresh quantity of lead, an operation termed stirring ("*Bleirühren.*")

The resulting "rich scrapings" have absolutely the same appearance as the roasted ore, containing, like it, metallic lead imbedded in the mass, and through the whole are perceptible brilliant scales of galena. Assayed with black flux, they give fifty-one per cent. metallic lead, which leaves, by cupellation, a button of unalloyed lead.

An analysis of this substance, made in the same manner gave the following results:—

Oxide of lead	0.305
Sulphuric acid	0.037
Lime	0.116
Oxide of iron	0.012
,, zinc	0.038
Sulphuret of lead	0.061
,, iron	0.029
,, zinc	00.74
Silica	0.028
Sulphate of barytes	0.051
Metallic lead	0.183
	0.934

An examination of the above analysis will show that this substance differs but little from the roasted ore, for it is nothing more than a product of roasting, except that the oxides are present in larger quantity from the nature and length of the process. By comparing the lime with the sulphate of barytes, it will be perceived that this base has nearly doubled. Can this be attributed to the want of homogeneousness of the substance, or may we not rather suppose, that a small quantity of lime has been added during the process, (which is sometimes done), either to saturate the sulphuric acid, produced in abundance by continued roasting, or to diminish the fusibility of the substance exposed to a more elevated temperature during the stirring process?

The "rich scrapings" yield no more lead by a simple re-action, because a part of the oxide undoubtedly forms with the sulphuret, an *oxi-sulphuret*, on which the oxide does not act; it is, therefore, necessary to have recourse to charcoal for reducing the latter and liberating the sulphuret; by again roasting it, the newly generated oxide acts on the sulphuret, and thus by successive reductions and oxidations, the scrapings are exhausted of nearly all the lead. The charcoal has also the effect of rendering the mass porous and offering channels to the metallic lead imbedded in the mass for flowing into the iron receivers; indeed, both the preceding substances contained such metallic lead, while the "poor scrapings" now remaining, are almost wholly destitute of it.

This residue differs from the preceding in not containing metallic lead, and in presenting a more homogeneous appearance. Heated with black flux, it yields 5.7 per cent. of lead, which gives a button of silver by cupellation, much larger than that of the rich residue.

It contains no sulphuric acid except in combination with barytes; the analysis was conducted by first treating it with acetic acid, and then the operation was continued as in the preceding materials; there was found as in the preceding cases, it is composed of:—

Oxide of lead	0.020
Lime	0.318
Protoxide of iron	0.062
Oxide of zinc	0.154
Sulphuret of lead	0.050
,, iron	0.038
,, zinc	0.138
Silica	0.056
Sulphate of barytes	0.148
Metallic lead	0.012
	0.996

It is apparent from this analysis that the charcoal had the effect of destroying the oxide and sulphuric acid; the sulphate of barytes is, however, unaltered, which probably arises from the great resistance to decomposing agents, which natural bodies present.

It is also worthy of remark, that this last product encloses a considerable quantity of sulphuret of zinc, which is the more surprising as blende is generally the first to be roasted.

Another not less remarkable anomaly relates to the silver contained in the ore, the quantity of which is small, but while the lead obtained during the first process, gives no indication of it, it is found in the other products, particularly in the last. We must, therefore, conclude, though contrary to what generally occurs, that the silver is concentrated in the last products.

This refuse yields no more lead, because the great amount of oxidized matter prevents the ulterior oxidation of the sulphurets; instead, however, of rejecting them, they are stamped, washed, and mixed with the crude ore.

From the preceding it may be gathered that the process pursued at Bleyberg is very simple, consisting in the transformation of a part of the sulphuret into oxide, in causing these to act on each other to produce lead, and lastly, in acting the sulphuret again at liberty to enable the fresh oxide to act upon it.

During the whole of this treatment, the substances are merely softened and preserve their sandy state, which is favourable to the successive oxidations and reductions that could not be performed on liquid or pasty masses. Care is also taken at the commencement, to heat the furnace moderately to avoid melting the galena, and to raise the temperature gradually, and only in proportion as the sulphuret diminishes, for then the fusion of the substances is not to be feared.

As already stated, the roasted ore, or the scrapings, subjected to a bright red heat in a clay crucible, did not undergo fusion, which must be attributed to the sulphate of barytes, and to lime, for, probably, the lime added during the process, is peculiarly adapted to that purpose. This is directly opposed to the ideas of M. Tournet (in a note in Ann. des Mines, 3e, Serie, T. II. "Théorie du traitement de la galena, au reverbère"), who asserts that sulphate of barytes is added in Carinthia, to promote the fusion of the gypsum which is generated. The insertion is incorrect, for the heavy spar is found in the mineral, and if any thing be added, it is lime, not however, for the purpose of rendering the gangue fusible, for it is important to prevent it, and by this means this end is attained, for, according to Berthier, (Ann. des Mines, 3e Serie, T. II.), the sulphates of lime and barytes do not form a fusible combination.

There remains 7.3 per cent. lead in the "poor scrapings," the amount of which, retained by the different combinations it forms with foreign substances, ought of course to increase with these. A tariff is employed at the works regulating the loss of lead according to the productiveness of the ore.

When the ore contains eighty-two per cent. the loss should not exceed two per cent., eighty, three; seventy-eight, four; seventy-six, five; seventy-four, six; seventy-two, seven; seventy, eight; sixty-eight, nine; sixty-six, ten; sixty-four, eleven; sixty-two, twelve; sixty, thirteen.

The poor residues were formerly treated alone, with a loss of twenty per cent. The workmen receive two and a half kreuzers (nearly ¾d.) for every pound they obtain beyond the tariff, and pay five kreuzers for every pound wanting. The table shews that the loss increases in rapid proportion, as the quantity of ore diminishes, the consequence of which is, that only very rich ores can be employed in this process, and indeed they only receive such as can give fifty per cent. in a small assay.

In order to bring the different ores to a convenient state of richness, they are subjected to preparatory mechanical operations, and very carefully washed; hence the work would be expensive with a high price for labour; at Bleyberg, however, a day labourer receives a very moderate compensation. It would be impossible to make the ore productive in many places, even supposing wages to be very low; it is when the metallic substances accompanying the lead, such as the blende and pyrites contained silver, in which case all these substances should remain in the ore. It follows, therefore, that the process of Bleyberg ought to be limited to certain localities, where, as in Carinthia, the contents of silver amount to almost nothing.

With regard to the advantages derivable from the Carinthian method, they are considerable, when taken in connexion with economy of fuel, as may be shown by a comparison of it with the analogous process pursued at Poullaouen. At Bleyberg eleven to twelve cubic feet of wood are consumed in obtaining the quintal of lead. According to a treatise of M. Baillot, they obtained at Poullaouen, in 1824, from an ore containing sixty per cent. lead, only forty-two per cent., showing a loss of thirty per cent.; but this loss is not real, for a part of the lead is obtained on an ore hearth, though it then requires another operation. The loss at Bleyberg for ores containing sixty per cent. is only thirteen per cent. In order to obtain one quintal of lead, forty-seven to forty-eight cubic feet of wood are consumed, or four times as much as at Bleyberg. Again, they there destroy six pounds of iron instruments per quintal; at Bleyberg, on the other hand, only one-fifth of a pound; this arises from the formation of much sulphate during roasting, which, being afterwards decomposed by the charcoal and iron, converts the latter into sulphuret. The Carinthian method possesses, therefore, great advantages, being convenient and easy of execution, requiring only one workman during a "*poste*" of twenty-one hours, the consumption of fuel and loss of lead being inconsiderable. But only small quantities can be operated on in this manner, for in twenty-one hours the amount of lead produced, does not exceed four and a half, or five quintals, French. At Poullaouen, they obtain in the same time, or even in eighteen hours, twelve to thirteen quintals.

It is probable that the employment of a large furnace in this method, would destroy its advantages, the facility of labour and economy of fuel; in fact, at Poullaouen, the greatest expense for fuel is incurred during the reducing process, when the temperature must be very high, although the furnace is considerably enlarged by a diminution of the substances. At Alsau and Holzapfel, they likewise employ the Carinthian method, operating only on small quantities.

FOREIGN LOANS.

STATEMENT OF THE LOANS RAISED IN ENGLAND BY THE NEW STATES OF AMERICA.

States.	Amount of Principal.	Rate of Interest.	Amount of Interest.	Arrears due.	Years.	Months.	Amount of Arrears.	Total Debts and Interest.
Colombia*	£2,000,000	Per Cent. 6	£120,000	May 1, 1826	10	8	£1,280,000	£10,859,500
Ditto	4,650,000	...	279,000	July 1, 1826	10	6	2,929,500	
Mexico, Old	3,150,000	...	†189,000	January 1, 1833	4	...	448,880	8,764,400
Ditto	2,130,000	5	106,500	Ditto ditto	4	...	279,570	
Ditto, New	1,570,000	6	94,200	April 1, 1836	...	9	70,650	
Ditto	1,075,000	5	53,750	Ditto ditto	...	9	40,300	
Peru	1,800,000	6	108,900	October 1, 1825	11	3	1,225,100	3,025,100
Chili	1,000,000	6	60,000	March 1, 1827	9	9	585,000	1,585,000
Buenos Ayres	1,000,000	6	60,000	July 1, 1827	9	6	570,000	1,570,000
Guatemala	167,000	6	10,000	Feb. 1, 1828	8	11	90,000	257,000
	18,542,000		1,081,350				7,519,000	26,061,000

* The Colombian debt is proposed to be apportioned as follows:—

States.	Amount of Principal.	Rate of Interest.	Amount of Interest.	Arrears due.
New Granada	£3,325,000	Per Cent. 6	£199,500	£2,128,000
Venezuela	1,895,000		113,700	1,144,800
Equator	1,430,000		85,800	936,700
Total	6,650,000		4,399,000	4,209,500

† The Old Mexican loan was chargeable with only half this interest up to the 1st of April, 1836.

London, Dec. 3, 1836.

On the use of Nicol's Calcareous Spar Prism in Discovering Shoals in the Ocean.—It has been remarked by M. Arago, that the bottom of the sea or the surface of a shoal at a given distance from a ship, is more distinctly seen from its mast-head, or, generally speaking, from a considerable height, than from the deck. He explains this phenomenon on the principle, that the reflected light from the surface of the sea, which is always intermixed with that from the bottom, or the shoal, possesses a less degree of intensity, in proportion as the angle of reflection, reckoned from the surface is larger. That this reflected light may be entirely removed, when looking into the sea to discover cliffs or shoals, he proposes to observe them by means of a Tourmaline, in which the axis is held horizontally, if possible, under a polarising angle of thirty-seven degrees, reckoning from the surface. Poggendorf proposes to use, for this important purpose, Nicol's Calcareous Spar Prism, because, from its being colourless, it is much better fitted for the purpose.

Paper.—A new species of paper has been invented by a Mons. Masard, a French paper manufacturer, which, according to report, is likely to prove of great benefit to commerce. From this paper it is impossible to obliterate anything which has been written, without its exhibiting some mark, and losing its original whiteness; it will resist every chemical agent; and can be manufactured of the best quality at a very moderate price. Some eminent scientific men have given their opinion that full confidence may be placed in the alleged qualities of this paper.—*Athenæum.*

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The Mining Journal

AND COMMERCIAL GAZETTE.

SUPPLEMENT—XII.

REVIEWS.

Transactions of the Geological Society of London. Second Series. Volume IV., Part the Second. London, 1836. Published at the Apartments of the Geological Society, Somerset House.

[Second notice.]

In the present quiet and stable condition of the surface of the globe, the tremendous physical agencies which were originally employed in bringing about its present configuration, have become almost inert and powerless, and we now experience little more than their expiring efforts. The relative boundaries of land and water, now form one of the permanent as well as the most important arrangements of the earth's surface—the rigid scrutiny of geological observers, has, indeed, proved that variations do take place, but these are well ascertained to be small and local. From some coasts the sea is known to be slowly receding, while on others it is gradually extending and submerging the land. Further than this, it is established that the relative *level* of the land and the ocean is by no means permanent, and that over considerable districts, the former is gradually becoming more elevated, thus forming a miniature representation of the grand phenomena of those ancient geological periods, when the land first rose from the bosom of its parent ocean.

The labours of Cuvier and Brongniart in the district surrounding Paris, first developed those more complicated movements, which the surface of the earth underwent during the tertiary epoch, those oscillations of sea and land which produced the alternation of marine and freshwater deposits, of which the Paris basin affords so remarkable an example. The researches of Mr. Webster, in the Isle of Wight and on the adjoining coast, shortly afterwards indicated the existence of similar phenomena in the tertiary deposits of our own country, while it was observed that appearances somewhat analogous were presented by a portion of the secondary strata.

The frequent occurrence of the *vivipara fluviorum* in the calcareous strata, associated with the great argillaceous deposit termed the "Weald Clay," was long since supposed with much justice to indicate an estuary or freshwater origin, and subsequent observations have confirmed fully the correctness of this opinion. The theory of the Wealden formation is discussed by Dr. Fitton, in the concluding portion of his paper on "the Strata between the Chalk and the Oxford Oolite," noticed in our last Supplement, and from his own attentive examination of that portion of our stratification, and the numerous observations he has brought to bear on the subject, we may receive with much confidence the opinions he has expressed.

The following extract will best convey to our readers, the theoretical views which Dr. Fitton's researches have led him to adopt with reference to these deposits:—

"The mode in which the Wealden is disposed, in the south-east of England, accords with the hypothesis of its having originated in a lake of fresh water, or in the estuary of a large river. It remains to be determined whether similar deposits are found to occupy a corresponding situation in other parts of the great European basin, of which England is but a small portion.

"The chalk and green-sands in England are so frequently prolonged beyond the limits of the beds below, concealing their outcrop, that no certain inference can be drawn with respect to the continuity beneath them of the Wealden and Portland strata. It is not improbable that what now appear to be detached portions, may in many cases be united; but it seems to be consistent with the mode in which freshwater deposits have been formed, whether in lakes or estuaries, that they should, in more extensive regions, occur in detached, rather than continuous portions; and that the outlines of the spaces which they occupy should be irregular. The former existence of the upper Wealden strata in the interior of England, is rendered probable by the erosion of the Purbeck beds in many places where the Lower green-sand comes into contact with them, (151.) p. 286,—which has clearly been effected by the action of water, and proves that something was carried away, before the sand was deposited: the argument from these appearances being the same as that derived from the erosions on the surface of the Oxford oolite and of the chalk, (143.) p. 274.

"The great extent of the surface occupied by water in North America is a striking feature in every ordinary map. Dr. Richardson, in his observations on the geology of that region, has remarked that a large tract near the confines of the primitive and secondary regions is occupied by lakes of the most varied outlines and dimensions;—in which the deposition of shells and other exuviæ of organized beings has been going on ever since the surface of the globe assumed its present aspect. If that part of the northern hemisphere were now to be sunk beneath the sea, we should probably have, after a short time, one universal sheet of marine strata, lodged upon the surface of the present land, so as to conceal not only the deposits of the several lakes, but the intervals between them: and if we could, then, examine the internal structure of the tract, we should find it to be occupied by a numerous series of *Wealdens*, detached from each other, and bordered, it is more than probable, by deposits analogous to those of the dirt-beds of Portland, wherever the fluctuations of the lacustrine waters left time and space for the growth of plants upon their margin. The external boundaries of these deposits would be as various and irregular as that of the lakes which now diversify the map of North America: and we should expect, in such cases, that the mineral components in the deposits of the lakes, would vary according to the nature of the surrounding land. Their fossil contents would, probably, have a great general resemblance throughout large districts; but, in the remoter tracts would differ as much as the productions of modern lakes are found to vary;—as those of the lakes in the North of England differ from those of Switzerland, and both from those of the South of France, &c.; or, as in America, those of *Slave-Lake* differ from the productions of *Lake-Superior* or *Lake-Erie*. The lacustrine deposits, again, would be occasionally diversified by the presence of the products of estuaries, such as those of the St. Lawrence and of other rivers around Hudson's Bay and the north-east coast of America; and in these we should probably find, along with the species of shells which usually inhabit the mouths of large rivers and the borders of the sea, some scattered remains of the products of the adjacent shores,—the plants and animals of the land, with some admixture of freshwater shells."

The immense deposit of the new red sandstone which prevails so extensively over a large portion of central England, stretching also to our north-eastern and north-western coasts, had not hitherto received that attention it deserves, in the countries of Lancashire and Cumberland, and the paper by Professor Sedgwick, is devoted in the present number of the Geological Society's Transactions, is devoted to the examination of this tract of country, embracing also some notice of the older rocks which are here associated with this sandstone.

In the following passage Professor Sedgwick remarks, on the extensive denudation which appears to have prevailed over a portion of this tract:—

"These detached masses of the new red sandstone prove, at least, that the formation was at one time expanded over a much larger surface than it is at present: indeed, there can be little doubt that it once extended, in a continuous mass, from the shores of Cumberland to South Lancashire and Cheshire. That much of it has been swept away, is shown by the whole aspect of the neighbouring country. I have already noticed the accumulations of old alluvial detritus south of Eden; but they bear no comparison to the vast heaps of similar materials which cover, to an unknown depth, nearly all the tracts of low land bordering on the coast of Cumberland: and all the islands off the coast of Low Furness are exclusively composed of rounded masses of rock (sometimes many tons in weight,) brought down from the old Cumbrian and Lancashire chains, and imbedded in a kind of red alluvial loam derived from the degradation of the red sandstone. In some parts of the coast the alluvial conglomerates are solidified, and only to be distinguished from the true conglomerates of the new red sandstone by the greater freshness of the imbedded pebbles: for the pebbles of the old conglomerates (however distinguishable in mineral structure,) have, in the regions I am describing, almost universally undergone a progress towards decay, and are sometimes hollow and entirely incoherent."

The general phenomena of the new red sandstone series, in the district under consideration, are thus described:—

"Before I go on to the next section of this paper, it may be well briefly to recapitulate.

(1.) "The red sandstone series above described appears among the last ramifications of the Eden, in a position decidedly unconformable to the carboniferous limestone.

(2.) "In its prolongation it rests upon the upper portion of the carboniferous series; and, in the long range from Appleby to Maryport, there are few places where the two formations can be shown, by their dip or inclination, to be in an unconformable position.

(3.) "At St. Bees Head it has apparently the same dip as the coal measures. But in the same neighbourhood it is proved to pass obliquely over their outcrop; and, after overlapping the mountain limestone, to range along the flanks of the primary mountains.

(4.) "It overlies the carboniferous system of Low Furness, and reappears in the next promontory, as a conglomerate unconformable to the mountain limestone.

"It offers, therefore, most obvious analogies to the new red sandstone series of many other parts of England. In one respect, however, it greatly differs from the overlying red sandstone of the great Bristol and Welsh coal fields; as its beds are, in a part of its range, not only parallel to the beds of the carboniferous series, but appear, through an intermediate sandstone, so nearly to pass into them, that it becomes extremely difficult to define the precise limits of the two formations."

We extract the following brief notice of the Whitehaven coal field, which is, however, only incidentally noticed by Professor Sedgwick, the object of his paper being as before observed, to describe the superincumbent formation of the new red sandstone:—

"The rich coal field of Whitehaven, constituting that part of the carboniferous series which is superior to the millstone grit and mountain limestone, may be separated into two divisions, the upper containing the great *main* and *bannock bands*, the lower containing four or five workable beds, but of inferior quality. The united thickness of these two divisions is, perhaps, not less than two thousand feet; and from this estimate the carboniferous limestone and its associated beds are of course excluded. The upper beds are worked in a small field on the coast, immediately south of Workington: but in consequence of an enormous *upcast fault* they are thrown out, and the lower division is brought into the cliff, and occupies an extensive plateau stretching from Harrington to the hills north of Morresby, about two miles and a half from the harbour of Whitehaven. Near the crown of these hills (and about a mile from the point where the accompanying section commences) another great fault, producing a *downcast* to the south-west, probably of not less than a thousand *feet*, once more brings in the upper rich division of the coal field. Unfortunately, however, between this *fault* and the village of Parton, the beds dip to the east; so that all those which are below the high-water mark necessarily crop out under the sea. The result is, that no one has been able to extract the coal, in consequence of the great quantity of sea water which finds its way through the beds along their planes of dip.

"At Parton there are other considerable dislocations, not merely altering the relative level of the beds, but again producing a reversed dip, by which the whole series of coal measures, as well as all the overlying groups extending to St. Bees Head, are made to plunge to the south-west at a small angle of inclination. The successive strata, therefore, after this last inversion of dip, have their outcrop in the interior of the country; and the coal seams are perfectly protected from the sea water by the impervious overlying beds of shale.

"Such is the position of the submarine portion of the coal field of Whitehaven; and it does not seem possible to assign any limit to the works that may there be conducted under the sea in the direction of the dip. But it is foreign to my purpose to give any description of these works, as the preceding remarks are introduced for the sole purpose of explaining the nature of the base line on which the accompanying section is constructed."

We conclude our extracts from Professor Sedgwick's paper, by the following "general comparison of the red sandstone series of Scotland and England." It is proper to observe that from a short postscript appended to the article, it appears that since it was read before the Geological Society (about five years ago) some of the views of the author, as regards the identification of a portion of the red sandstone series, have been considerably modified by the researches of Mr. de la Beche and other geologists:—

"It has been shown by Mr. Murchison and myself, that in the Isle of Arran a carboniferous series is interpolated between two enormous masses of red sandstone and conglomerate; and that the whole group passes, in the ascending order, into a formation of red sandstone, which *may represent* either one of the red, sterile parts of the Scotch carboniferous series, or the lowest division of the new red sandstone. It is almost impossible to ascertain the precise limit of this upper red sandstone of the Isle of Arran: but the best way of approximating to it would be to trace the old red sandstone group from the south flank of the Grampians to the west coast of Scotland; and from thence to follow the red sandstone series to the coasts of Ayrshire. By the help of such an examination (a desideratum in Scottish geology), we might perhaps establish such analogies as would enable us to determine the exact upper limit of the Arran section.

"I consider it now established beyond doubt, that the great masses of red sandstone and conglomerate which fringe the Highland coasts, and range, on the south flank of the Grampians, from one side of Scotland to the other, belong almost exclusively to the old red sandstone. The large development of the bituminous schist of Caithness has thrown some unnecessary difficulties in the way of this conclusion. It alternates, however, with the old red conglomerates to their base, and cannot be separated from them; it is overlaid by a red sandstone decidedly of older character than any variety of the new red and variegated group ever seen in other parts of Great Britain; it contains a suite of fossils peculiar to itself; not, as far as is known, interchanging a single species with the magnesian limestone; it is represented (and by no means in an unusual form) on the south flank of the Grampians by a series of thin-bedded strata, placed by Mr. Lyell even lower than the old red sandstone: and, lastly, the remains of fish have been found by Dr. Fleming in groups of slaty sandstone, which, though superior (like most of the Caithness schists), to the lowest old red conglomerates, are inferior to the true carboniferous formations of Fifeshire. I conclude, therefore, that the true position of the ichthyolites of Caithness is out of all doubt, and adhere with very slight modifications, to the classification published by Mr. Murchison and myself.

"By way of conclusion, I may add, that the anomalies at which I have pointed, in different parts of this paper, and the difficulties they throw in the way of any universal classification, can be no matter of surprise. The great cause for wonder is, that among such vast and rude, mechanical operations of nature, we should be able to trace even the approximate elements of order. Whatever may be hereafter decided about the general groupings of the coal measures, the near coincidence of even the minute mineralogical subdivisions of the new red sandstone series in the North of England and central Germany, and the general correspondence of their fossils, must be regarded as one of the most satisfactory conclusions of secondary geology."

We shall now proceed to make some extracts from a valuable paper by Colonel Sykes, on the Geology of a portion of the tract termed the Dukhun, in the East Indies, but, better, perhaps, known to our readers by its more usual orthography, as the *Deccan*. We need hardly observe how valuable every information must be, which opens to our view the geological structure, and hence of necessity the mineral resources, of the vast eastern empire which the genius and valour of our countrymen, have placed beneath the sway of Great Britain. The great survey of India which has been proceeding for some years, and has now made considerable progress, will afford all the details which can be required, as regards territorial extent, geographical localities, and all those physical features which are imprinted on the surface, but even this will be imperfect unless some attention be also paid to the stratification of the country, to the position and extent of the great mineral masses which form its mountains and plains, and which may often contain, in their bosom productions of the highest interest and importance, both to the natives of the soil, and to its European rulers. We are aware that many valuable contributions to the geology of India, have been furnished by individual research, and of this the paper under consideration forms an illustration, but when we consider the vastness of the field, the difficulties presented by the climate, and other obstacles, we cannot help feeling that individual enterprise, however valuable in giving us some insight into this vast and almost unexplored region, is totally inadequate to its perfect development, and that the full accomplishment of this great object can only be effected by its being systematically commenced under the auspices of the Company, and rendered co-extensive with the geographical survey to which we have before alluded.

Deprived of the privileges of trading, and thrown entirely on its territorial resources, the East India Company would well consult its own interest as well as the advancement of science, by exploring with diligence the internal structure and mineral productions of the vast territory which it possesses, nor have we any means of anticipating the advantages which would arise, were the course we have pointed out to be pursued.

Returning to Colonel Sykes's paper, we shall in the first place extract the following description of the *Ghâts*:—

"The Dukhun rises, by a succession of terraces or steps, very abruptly from the Konkun. Its valleys and table-lands have a mean elevation above the sea of about 1800 feet. The Konkun is a long strip of land from thirty to fifty miles in breadth, lying between the Ghâts and the sea; the mean elevation of this strip is less than 100 feet; but it is bristled with isolated hills, or short ranges, some of which attain an elevation equalling that of the Ghâts. Numerous shoulders or salient angles are thrown out from the Ghâts from the western or Konkun side, and by means of these the ascent to Dukhun is effected; with what difficulty, will be understood when I state that the military road of communication between Bombay and Poona, up the Bore Ghât, rises nearly 600 feet in a mile. The western portion of my tract along the crest of the Ghâts is exceedingly strong: spurs of different lengths extend from the main range to the eastward and south-east, leaving many narrow tortuous valleys between them, some of which have the character of gigantic cracks or fissures; other valleys although occurring less frequently, when looked at from the neighbouring ranges, appear as flat and smooth as a billiard-table, even to the crest of the Ghâts, but when traversed are found to be cut up by numerous narrow and deep ravines. Stupendous scarps, fearful chasms, numerous waterfalls, dense forests, and perennial verdure, complete the majesty and romantic interest of the vicinity of the Ghâts. As the spurs extend to the east and south-east they diminish in height, until they disappear on approaching the open plains in my eastern limits, between the Beema and Seena rivers. The area of the table-land on their summit often exceeds that of the valley between them: such is the case with the spur bordering the left bank of the Beema river for forty miles from its source, occupying, in fact, the whole country between the sources of the Beema and Goreh rivers. The spurs are rarely tabular for their whole length, but narrow occasionally into ridges capped with compact basalt, and subsequently expand into extensive table-lands. The spur originating in the hill fort of Hurreechundurghur affords a good example. The fort is about eighteen miles in circumference: on the east it presents a salient angle to the neighbouring mountain; absolute contact, however, only commences at about 400 feet from the top of the scarp, leaving a gap and an extremely narrow ridge, over which lies a difficult footpath of communication between the valley of the Malsej Ghât and that of the Mool river. The spur then widens: some lateral ramifications shoot out, on one of which is situated the fort of Koonjurghur; at the Brahmun Wareh pass it narrows considerably, but not into a ridge; it subsequently expands into the extensive and well-peopled table-land of Kanoor and Parneir, twenty-four miles long by twenty broad, having diminished in height, by a succession of steps, from 3894 feet in Hurreechundurghur to 2866 at Brahmun Wareh, 2474 at Parneir, and 2133 on the terrace of Ahmednuggur. From Ahmednuggur the spur bends southward until it is finally lost in the neighbourhood of Sholapoor. It is, in fact, the margin of a great plateau, which has a mean elevation of about 300 feet above the valley of the Godavery river, and over which the rivers Goreh, Beema, Seena, &c., take their course. The basaltic caps of the ridges appear more or less columnar, from numerous vertical fissures; the weathering of these exposed rocks produces pillars, spires, towers, houses, and other forms of works of art. Another feature of these spurs is the occasional occurrence on their table-lands of small hummocks or conical hills with a truncated apex. Dr. Voysey mentions 'groups of flattened summits and 'isolated conoidal frustra' in the Gawelghur trap mountains.'"

The following extracts describe some of the peculiar features of Indian Geology:—

"*Loose Stones.*—Another feature of Dukhun is the occurrence of immense quantities of loose basalt stones, as if showered upon the land; also masses of rock heaped and piled into mounds as if by the labour of man. Their partial distribution is not less remarkable than their abundance. For the most part, the stones have a disposition to a geometrical form, and it is by no means rare to meet with prisms of three or four sides and cubes almost perfect: stones with one or two perfect planes are very common. Their texture is close-grained and the colour verging to black."

"*Rocky Heaps.*—The singular heaps of rocks and stones above noticed occur at Kanoor, Patus, Kheir, between Kurjut and Meerujgaon, and at other places in the Desh, but not in the Mawals, or hilly tracts of the Ghâts. The heaps are from twenty to seventy feet in diameter, and the same in height: when composed of rocky masses without small stones, blocks of three or four feet in diameter and with a disposition to determinate forms, are piled upon each other, constituting rude pillars. In certain parts of the country from fifty to sixty of these heaps are seen within the area of a couple of square miles, and it excites surprise that the intermediate ground is destitute of stones."

"*Sheets of Rock.*—Mention must not be omitted of the constant recurrence of sheets of rock of considerable extent at the surface, and totally destitute of soil; this is particularly the case in the Mawals, or hilly tracts along the Ghâts. They abound with narrow vertical veins of quartz and chalcedony. When of sufficient thickness, the vein splits in the centre parallel to the surface of its walls, the interior being drusy with quartz crystals: the walls

consist of layers of chalcedony, cachalong, hornstone, and semi-opal. These veins supply the majority of the siliceous minerals so abundantly strewed over Dukhun."

In the following passages we find the results of Colonel Sykes's observations, as regards the minerals, natural salts, ores, and organic remains of the tract which he has examined:—

"*Minerals.*—Minerals are not uniformly dispersed in Dukhun. In one part quartz predominates, in another chalcedony; and these are more or less associated with jaspers, agates, hornstones, heliotrope, and semi-opal or cachalong. In other places particular members of the zeolite family prevail, nearly to the exclusion of the siliceous class; and elsewhere there is a diminution of minerals amounting almost to privation. Amethyst quartz is rare in Dukhun; when met with it constitutes the crystal, lining the interior of geodes of agate, I have not seen it in veins. Pseudomyrphous quartz is common; the most frequent impression is that of rhomb spar. Lime occurs only in three crystalline forms: rhomb, dog-tooth, and the dodecahedron. The first is found on the surface, and imbedded in masses of quartz and compact mesotype; the two latter forms are associated with ichthyophthalmite in cavities in the amygdaloid strata."

"*Natural Salts.*—Only two kinds of natural salt came under my notice, namely, muriate and carbonate of soda."

"With respect to the former, many of the wells at Ahmednuggur are brackish; and there is a rivulet running into the Seena river about two miles north-west of the city, which has its source a few miles distant, called the Salt Brook. It passes over a saliferous soil; and in its dry bed, or on insulated stones standing in its stream, are incrustations of common salt intimately mixed with carbonate of lime. No use is made of this salt. The saline impregnation of the soil extends to some distance west and north-west of Ahmednuggur, as I found a handsome well at Kurjooneh, eight miles distant, filled with water so brackish as not to be available for domestic use. At Wurgaon, between Kurjat and Palrgaon, a peculiar hoary appearance of a datch of ground in the midst of withered grass, led me to examine it. The whiteness was occasioned by lime in minute particles, mixed with a little muriate of soda.

"The third locality of common salt was in the bed of a rivulet at Koond Mawlee, near the falls on the Kookree river, between Serroor and Kowta. A little common salt, with a trace of carbonate of soda, appeared, incrusting the rocky bed for a few feet near the water line. I did not observe common salt elsewhere. My attention was first directed to carbonate of soda at Serroor, by observing washermen digging for earth in the banks of a rivulet; learning that they used it to wash their clothes, I obtained a quantity; lixiviated the earth, boiled down the lixivium, and on cooling obtained a large crop of crystals, which the usual tests indicated to be carbonate of soda. I only met with one other bed, although I have no doubt they are numerous. At Kalbar Lonee, twelve miles east of Poona, and two miles south of the Mota-Mola river, within an area of 200 yards, a constant moisture and partial absence of vegetation is observed. An efflorescent matter appears on the surface every morning, which is carefully swept up and sold to washermen: it is carbonate of soda. The occurrence of salts in the trap formation did not escape Captain Dangerfield's notice. He states that 'the banks of the Nerbuddeh (Nermada) near Mundleysir, consist of an upper thin bed of vegetable mould; a central bed, chiefly of indurated marle, strongly impregnated with muriate of soda; and a lower bed, of a reddish hue, with much carbonate of soda. In the dry season these salts form a thick efflorescence on the surface of the bank.' Saltpetre is manufactured in Dukhun, not from nitrated soils, but from the scrapings of old walls. I have also seen specimens of muriate of ammonia obtained by the brick and tile makers in burning dung, stable and other refuse matters in their kilns."

"*Ores.*—No other ore than that of iron is found in Dukhun. It is only worked, to my knowledge, at Mahabuleshwur, at the source of the Krishna river. It occurs as a nodular hematite, associated, I understand (for I have not been at the spot myself), with laterite. This ore produces the celebrated Wootz steel."

"*Organic Remains.*—I did not meet with organic remains of any kind whatever. Captain Coulthard in Sagar, Major Franklin in Bundelkand, and Captain Dangerfield in Malwa, were equally unsuccessful. Dr. Voysey, indeed, mentions a bed of freshwater shells in a stratum of indurated clay near the Tapty river in the Gawelghur hills; also at Medconta, 2000 feet above the sea, on trap; but these may have been recent, as he does not say to the contrary. Mr. Calder, in his general observations on the Geology of India, says, 'But hitherto the most striking phænomenon in Indian geology is the almost total absence of organic remains in the stratified rocks and in the diluvial soil.' As this must have been written with a knowledge of Dr. Voysey's paper, it being in the same volume with his own, it is probable he considers the shells recent."

With regard to thermal springs, Colonel Sykes observes:—

"*Thermal Springs.*—Thermal springs do not exist in Dukhun within my limits; but there are three distant localities in the Konkun below the Ghâts, where hot water gushes up from numerous crevices in trap rocks over an extensive surface."

The concluding paper in the present Part of the "Geological Society's Transactions," is one by Mr. Leonard Horner, on the "Geology of the Environs of Bonn," our notice of which, space compels to be deferred to our next Supplement.

A Treatise on Isometrical Drawing, as applicable to Geological and Mining Plans, Picturesque Delineations of Ornamental Grounds, Perspective Views, and Working Plans of Buildings and Machinery, and to general purposes of Civil Engineering, with Details of Improved Methods of Preserving Plans and Records of Subterranean Operations in Mining Districts.

Geological Sections of Holyfield, Hudgill-cross Vein, and Silver Band Lead Mines in Alston Moor and Teesdale, showing the various Strata and Subterranean Operations. Coloured, and accompanied by Letter-press Description.—By T. SOPWITH, C.E. Weale, Architectural Library, 59, High Holborn. London, 1834.

The works which we now introduce to the notice of our readers have been for some time before the public, and are probably well known to many. On this account our notice will be brief, although we consider the volumes to which we refer to be of much practical value, and, therefore, feel great pleasure in rendering them as widely known as possible.

The great experience of Mr. Sopwith, as a land and mine-surveyor, has led him to pay much attention to that species of projection termed "Isometrical Drawing," which we cannot, perhaps, more simply describe to our readers, than by saying, that it is somewhat similar to what is generally termed, a "bird's-eye view"—the spectator being elevated above the object he looks at, and placed obliquely with regard to it, so that he commands a view both of its upper surface and two of its sides. This species of projection has the further peculiarity of admitting of measurement, by scales constructed for the purpose, so that while it presents the advantage of a perspective drawing, it avoids that distortion which would be extremely prejudicial in those cases for which Mr. Sopwith recommends its adoption.

The "Treatise on Isometrical Drawing" is the *demonstration* of the principle before alluded to, and the three works to which we call attention are one whole developing, the idea which has for years possessed the author's mind, and proving the correctness of his views. He begins by observing—

"The great expense attendant on mining operations, the strict geometrical accuracy required in projecting and conducting them, the difficulty of access which militates against a frequent and close inspection of the interior of mines, and the decay which, on their abandonment, so speedily renders them altogether inaccessible, are circumstances which strongly evince the great importance of having clear and accurate delineations of the several works connected with them. To lead mines these remarks are particularly applicable; for in these workings which have been long abandoned, frequently are the objects of fresh adventure, and a needless repetition of labour and expense is often incurred by ignorance of what had formerly been done. That minute and faithful records of all subterranean works, in important mining districts have not been carefully preserved, is a matter of regret to all who are practically acquainted with the nature and utility of such documents."

Mr. Sopwith quotes the authority of the great Werner in proof of his position, and proceeds—

"The prospects of mining cannot, indeed, be reduced to certainty, but it is exceedingly desirable *that all the details of conducting it* should be so. An intelligent system of this kind would attach to it a character of skill and method, for want of which it is much undervalued as a means of employing capital, an opening has been thus afforded to impositions which have greatly lessened the public confidence in such undertakings. Whatever tends to increase a knowledge of mining, undoubtedly contributes to its permanent interests; and if the present depression of the markets continue, if prices will not rise to meet the present and increasing expenditure of mines, there is the greater necessity for the adoption of every means to promote future economy, and to prevent future waste."

The evils of the existing discrepancies in plans, and the value of an understood arrangement on which all should act, supplying as it were, a common language among surveyors, is insisted on.

"Among other causes which contribute to the imperfect state of mining plans may be mentioned, the want of a popular treatise on the subject, which should familiarly explain the mode of using different surveying and drawing instruments, illustrate the principles of representing horizontal, vertical, and inclined planes, and point out the best way of taking the measurements required for each. Examples should be given of the best methods of representing the different parts of mines, and an attempt be made to fix on general characters for that purpose. For want of such information, many miners, who can dial with accuracy, are at a loss how to represent on paper what they have measured; and some fruitlessly attempt to lay down and connect horizontal and vertical objects on one orthographic plane. What on one plan represents an adit, on another represents a vein or dyke; and such plans, therefore, for want of uniform modes of representing similar objects, can never be of any general or permanent utility."

The author proceeds to observe—

"For the preservation of records of subterranean works, a strictly accurate plan of the district in which they are situated is essential. Owing to several causes, plans of mountainous countries have not in general been constructed with that extreme regard to accuracy, without which any inference as regards either geology or mining must be fallacious. The want of system in reducing hills to a plain surface, the uncertain weather and boisterous climate of such districts, so unfavourable to the use of good instruments, and the neglect of a very strict and indispensable regard to the variation of the magnetic needle, have all tended to occasion a great want of accuracy in plans of mines and of mineral districts."

To supply the rules for drawing and securing such corrected plans is a principal object of the treatise before us, and the writer observes,—

"It would be well if *uniformity of scale and conventional signs* could be generally adopted for plans and sections in the respective districts of the coal and lead mines in the north of England. Such uniformity would be a most important point gained, towards obtaining that 'knowledge of our subterranean wealth,' which an eminent authority has justly observed, 'would be the means of furnishing greater opulence to the country than the acquisition of the mines of Mexico and Peru.'"

The best size for these plans is the most portable.

"So far as my observations of subterranean plans and sections extend, I am of opinion that imperial drawing paper is sufficiently large for preserving a clear and methodical series of working and other plans, and that, with a few occasional exceptions, all mining plans and sections might be delineated in squares of twenty inches, forming a superficial area of two feet nine inches and one-third, or, when unavoidably larger, in duplicates or quadruples of that area."

As regards the scales, Mr. Sopwith observes—

"The scales of geological and mining maps, so far as practical utility in any particular district is concerned, may be considered as varying from two miles to an inch to one chain to an inch. On the former, which is suited to the representation of a large tract of country, the square of twenty inches would represent a district forty miles square, including an area of 1600 square miles; while on the latter scale, which is the largest in common use, the same space would include a portion of land a quarter of a mile square, or a superficial area of forty acres."

The requisites and advantages of the new language are thus described—

"Next to *uniform scales*, the adoption of *common conventional signs* is of the greatest consequence. These may vary in different parts of the kingdom, owing to different strata, modes of working, &c.; but it is well worthy of the attention of land and mine owners in the north of England, to effect *uniformity in their plans and sections*, the value of which as an index to, and record of, their mineral property, would be exceedingly great. The owners and all other persons interested in such property, would thus be able to gain a clear understanding of the plans of them. Engineers or viewers from other parts could readily form an exact idea of the nature and extent of the several workings; each new manager would at once become acquainted with what had formerly been done, while successive generations would profit by invaluable stores of information, and would thus transmit, from age to age, legible records of a subterranean world of wealth."

After showing the necessity of attention to the true meridian, and reduction of undulations in the surface, with an example of the evil consequence of the neglect, he says,—

"It would be a work of infinite advantage to the prosperity of mining counties to have meridian lines cerefully set out at distances of one mile from each other, and tall posts or curroehs placed on these meridian lines at every mile in length, the undulating surface of the country being truly reduced to a horizontal base, so that these posts or stations should indicate squares of exactly one horizontal square mile. When rivers or other objects occur to prevent such posts being erected, the proper situation of them might be indicated by three or four marks placed at equal distances from them. The most important part of a district might be thus divided into square miles, and any one of these lines could at any time be continued in north, south, east, or west directions, so as to make a connection with other parts of the district.

"The course of veins and dykes could then be delineated through the several portions of a district with a degree of accuracy which can never be gained without such a basis. Even for surface plans these stations would be of great utility; and when an exact survey of one of these square miles was completed, all existing plans of the mines, &c., beneath it, could be delineated on one or more copies of the plan, according as different seams of coal, or different *randoms* of veins and workings might require, and all future surveys could be plotted exactly in their relative position to the former plans."

In illustration of these designs, and in confirmation of their practicability, Mr. Sopwith gives at great length the results of his own experience, and also the terms of his agreement with a mining company, the mode pursued in supplying the partners with the plans of the rich mining district of Silver Band, so interesting to the geologist, from its stratified range of basaltic rocks: and he proceeds to show, by the errors in existing geographical maps, the importance of attending to the data he has enumerated, and the rules he presents.

"The mining manor of Allendale consists of two valleys, formed by the east and west Allen rivers. In two recently published maps of the county, *the distance of these rivers is a mile different* for nearly the whole extent of these respective dales."

And this in a country where an error, even of a yard in length, has involved a difference of nearly 1000*l.*, for at that sum was valued every yard of the Rampgill vein, when surveyed by the celebrated Smeaton. With regard to the advancement of geological science, and the question whether it could be most easily secured by one or more maps, Mr. Sopwith observes—

"The publication of a series of maps would, I imagine, tend far to promote an acquaintance with, and general interest in geology, than that of a single large map. The letter-press, sections, and drawings, of each number, would be interesting to the public of each respective district. Many would examine, and learn to understand a map of the geological structure of the place in which they live, who would deem a county geological map far beyond either their interests or comprehension; and a printed cover of these numbers might also be a useful vehicle for publishing the nature and advantages of the ultimate objects in view."

From these maps might be constructed a general one, of the highest value, to which the ordnance surveys now in progress would add a value hitherto unknown.

The observations on perspective are useful, if not new; though the principles of isometrical projection are now more generally understood than they were when Mr. Sopwith's book appeared, and are more generally brought into practice. We cannot deny ourselves the pleasure of quoting his very neat, though brief, communication of some of its properties.

"Isometrical projection exhibits three *conterminous* or adjoining sides of a cube, having its under side on the plane of the horizon. Each of the three sides appears of equal size and shape, and *all the edges*, or boundary lines, are of equal length. In each side, two opposite angles are 120 degrees each, and the other two opposite angles of each side are sixty degrees each. The three angles formed at the corner nearest the eye, which is in the centre of the figure, are each 120 degrees. All the opposite boundary lines are parallel, and all lines drawn parallel to any of these boundary lines, will coincide with them, and may be measured by *one common scale*. By isometrical projection, *all perpendicular lines* may be measured by *the same common scale, and by no other mode of projection can all the edges of three sides of a cube be represented on paper, or any flat surface, so as to be measured by one scale.*"

Mr. Peter Nicholson says of it in his usual clear and lucid manner—

"Isometrical projection combines the uses of perspective and geometrical drawings of plans, elevations, and sections. It is of equal utility with perspective in showing how the parts of a design are connected together, and has this advantage over it in exhibiting the measures of those parts.

"Isometrical projection will either enable the artist to execute a design according to the intention of the designer, or the draughtsman, to make such a drawing of an object, or objects, already existing, whether land, machinery, or buildings, as will exhibit to another the measures and positions of the things represented."

The rules which follow, illustrated as they are by a variety of most interesting engravings, completely elucidate the principles, and teach the use of this style of drawing; and we must look at the work as proving that—

"As a means of cultivating a taste for the arts of graphic design, combined with geometrical science, isometrical drawing will be found an interesting source of amusement, and a useful and explanatory illustration of various subjects in geology and mining; for the delineation of ornamental grounds; for the easy and expeditious construction of architectural designs; and for various other purposes in the practice of civil engineering, and in the wide and varied circle of the mechanical arts."

To accomplish the objects at which we have now glanced, Mr. Sopwith has written much and well; and the public, which he has laboured for, will no doubt appreciate and reward his services.

The second work in the list of Mr. Sopwith's productions is a thin quarto, containing—

First.—A plan of Holyfield lead mines, in the Manor of Alston Moor, with a section of the strata. Here the wants of the practical man and the scientific geologist are supplied together. The vein throughout its course, its swinning and cross-veins, are the natural peculiarities of the locality; then the levels, low and high branches, cross-cuts, drifts, and the other means of access to the works; then the heaps of refuse and of ore, the railroads, the houses, and machinery by which it is purified; the floor, crushing-mills, and all similar works, are laid down for the information of the parties in the mine, and the direction of the miners. The section passes through the high slate-sill, the low slate-sill, the whetstone sill, the hazle called ironstone, the hazle called firestone, the hazle called Pattison's sill, the little limestone and little hazle; the coal and hazle, called the high coal sill, and the hazle called the low coal sill; these are above the veins; the quarry hazle, the girdle or till bed, the quarter fathom limestone, and the natrass gill hazle lie beneath it.

Second.—A plan of Hudgill Cross-Vein Lead Mine, in the manor of Alston Moor, where the workings and the section of the strata are given with equal accuracy and information; and even more delineation and beauty than in the former.

Third.—A plan of Silver Band Lead Mine at Cronkley, in the manor of Lune, in Yorkshire; and

Fourth.—A few pages of letter-press, descriptive of the several plans. This work is, therefore, a carrying out of the principles insisted on in the introduction to the account of mining districts; and presents an improved system of planning by ground plans and sections, which we recommend to surveyors and mining agents.

Scientific Memoirs, selected from the Transactions of Foreign Academies of Science and Learned Societies, and from Foreign Journals. Edited by RICHARD TAYLOR, F.S.A., &c. &c. Vol. i. part 3. Feb. 1837. Longman and Co., London.

The third part of this valuable work is now before us, and is fully equal, in the interest and variety of the papers which it contains, to the two previous ones, noticed in a former Supplement. It is with regret that we find a work calculated to be of so much service to science in this country, has not yet met with sufficient encouragement to repay its enterprising editor; and on this subject we cannot do better than to quote some portions of the preliminary address prefixed to the present number. Although far too abstruse to obtain general circulation, we feel it would be a disgrace to our country, were such a work to be discontinued for want of adequate support; and we are, therefore, desirous of making known as widely as possible, both its intrinsic value, and the circumstances under which it is now placed. After adverting to the general scope of the work, Mr. Taylor proceeds:—

"How far the execution of the design may have hitherto been generally satisfactory, I know not. The approbation and patronage of many distinguished persons of the highest scientific eminence greatly encourage me to persevere; but, as yet the number of purchasers has not been nearly sufficient to defray the cost of publication. I do not hesitate, therefore, to make an appeal to all who may participate in the wish for the continuance of the work, trusting that they will lead their active aid in promoting its success. With a demand sufficient to cover the expenses, I should determine to proceed, being more than ever convinced of the need of such a work, and having made various arrangements for its improvement."

* * * * * * *

"My connexions and my profession may afford me, perhaps, advantages for carrying on the work with a less amount of support than would be requisite if it were in other hands. I cannot, however, be expected to incur a considerable loss; and I look with confidence to those who approve my attempt to give me their active aid. If they wish the work to be continued, they will, I trust, exert themselves to increase the number of purchasers, which at present is far below what is absolutely necessary.

"I have only to add, that the attention requisite for conducting this work I shall be happy to give, if its circulation can be so far extended as barely to pay the cost; and, though necessarily it can hardly be of a popular character, this is not a greater degree of success than may be hoped for in this country and its dependencies."

The present number of the "Scientific Memoirs" contains translations of twelve papers, embracing many subjects of great interest

the higher departments of science, and especially those to which recent discoveries and researches have more particularly directed the attention of philosophers. Among these we may name, "Remarks on the real occurrence of Fossil Infusoria, and their extensive diffusion," by Professor Ehrenberg; "On the chemical effects of electric currents of low tension, in producing the crystallization of metallic oxides, sulphurets, sulphates, &c., in forms closely resembling the native combinations," by M. Becquerel; and an extremely valuable paper by M. Mozotti, "On the forces which regulate the internal constitution of bodies." The great abstruseness of this subject we need hardly allude to, nor can too much praise be given to the manner in which it is here treated, and which promises to throw much light upon it.

We take the following extracts from Professor Ehrenberg's paper on "Fossil Infusoria," as tending, in some measure, to illustrate this curious subject, which space will not allow us to enter further into:—

"The great mass of the specimens of these animal forms is in very good preservation: many of them are so beautifully preserved, that I have even been able to determine from them the characters of the living species more precisely; for a direct comparison of the latter showed that certain apparent characteristical distinctions are very difficult to be observed in the living ones, and have hitherto been overlooked by me. I first discovered the apertures of the Gaillonella in the Polirschiefer, and I now perceive them in all the species of the genus: I have never before seen the six apertures of *Navicula viridis* so beautifully.

"The great sharpness and clearness of all the outlines of all these siliceous shields, plainly appears to have been produced by an extraordinary red heat, which has evaporated all organic (particularly vegetable) carbon; for the animals then lived, as at the present day, on plants: at a later period the siliceous earths may have become separated, while the silex has better resisted destruction. Werner, indeed, was of opinion that subterranean fire had formed the Polirschiefer, an opinion which has much in its favour."

The extreme minuteness of the infusoria is described in the following passages:—

"With the Polirschiefer it is different; this forms widely extended layers, containing fossil plants and fishes. A single druggist's shop in Berlin consumes yearly more than twenty cwt.: the consumption, therefore, of infusoria as tripoli, and for casting-moulds in Berlin and the environs, may be, perhaps, estimated at fifty to sixty cwt. yearly, and thence we may in some measure infer the sale in Bilin. I hope to receive in a short time more extensive details on this subject: it is sufficient at present to say, that the infusoria supply all the requisite demands for purposes of practical utility. Passing over the share they have in the Raseneisen, the soldier cleans his arms with tripoli; the worker in metal, the locksmith, and the engraver, polish with infusoria, which serves also for moulds in foundries. These animals which are so useful after death, and form entire rocks, have at present a more special interest in their individuality. The size of a single one of these infusoria, which form the Polirschiefer, amounts upon an average and in the greater part to 1-280ths of a line, which equals 1-6th of the thickness of a human hair, reckoning its average size at 1-48th of a line. The globule of the human blood, considered at 1-300ths, is not much smaller. The blood globules of a frog are twice as large as one of these animalcules. As the Polirschiefer of Bilin is slaty, but without cavities, these animalcules are closely compressed. In round numbers, about twenty-three millions of animals would make up a cubic line, and would, in fact, be contained in it. There are 1728 cubic lines in a cubic inch, and, therefore, a cubic inch would contain on an average about 41,000 millions of these animals. On weighing a cubic inch of this mass, I found it to be about 220 grains. Of the 41,000 millions of animals, 187 millions go to a grain, or the siliceous shield of each animalcule weighs about the 1-187 millionth part of a grain.

"The animalcules of the Raseneisen are only 1-1000th line in diameter, or the 1-21st part of the thickness of a human hair, one-third of the diameter of the globule of the human blood, one-eighth of the blood globule of a frog. A cubic line of such animal iron-ochre would thus, in the same relation, contain one thousand millions, one cubic inch one billion, and one cube of nine feet diameter one drillion of living beings. If we suppose only one-fourth of this multitude to be really present, and take no notice of the other three-fourths, there yet remain such enormous numbers as to merit the greatest attention."

The occurrence of fossil infusoria in the semi-opal, is thus noticed:—

"The formation of the semi-opal in the Polirschiefer appears to be this, that it lies imbedded in it in nodules, in the most minute transitions from the Saugschiefer. A close microscopical analysis of the most varying semi-opals from Bilin, and the neighbouring valley of Luschitz, has shown that all these stone nodules, which sometimes equal flint in hardness, and give sparks, consist partly of infusorial forms, held together by a small quantity of transparent siliceous cement, and partly contain, inclosed within them, single infusoria, but of a larger size, just as amber contains insects. It is often very plainly to be seen, that the disposition of the Polirschiefer has not otherwise been altered, either by its change into Saugschiefer (cemented and permeated by amorphous siliceous matter), or by its change into semi-opal, than that by some means a part of the infusoria shells, particularly the more delicate ones, have been eaten away or dissolved, with which another part, especially of the larger forms, has been covered in an unaltered state. In this process the stratified structure remains as fully visible in the Polirschiefer as it had before been, and forms the stripes of the semi-opal. The white and the transparent stripes are mostly well-preserved layers of infusoria. It is not improbable that a dissolving medium may have acted upon the siliceous shells, as drops of water or steam act on meal. The parts in contact with it were gradually penetrated, and partly dissolved and changed into opal; or the penetrating matter, producing the opal, and which occupies but a small space, has assimilated to itself a greater or less part of the empty siliceous shells. The true wood-opal, in which the woody substance is changed into opal, renders the opinion probable, that a peculiar opaline mass has supplanted the decayed and dissolved parts of the woody substance, retaining, however, its form. We cannot easily imagine the expulsion of the siliceous shield-mass by the opal-mass, and of the latter filling its space: therefore it appears conceivable that the opal may be probably formed from the infusoria shells, simply by water, or any other dissolving medium except fluoric acid, just as dough is formed of meal. Unkneaded dough contains stripes of meal,—semi-opal has often stripes of infusoria: both are hydrates."

Very similar appearances are exhibited in flints, as we learn from the following passage:—

"It was natural for me now to test again the flint of the chalk, which I had before often examined: and this time I employed a higher power, and, therefore, with more success. The black flint, which broken into small pieces is transparent, showed no evident traces of an inclosure of microscopic organic bodies, but such are easily perceptible in the whitish and yellowish opaque pieces. The more rare horizontally striped specimens are very similar to the striped semi-opals. They all contain spherical and often needle-shaped bodies, at times with apertures, which can scarcely be an optical phenomenon, and which are covered by a transparent siliceous matter."

With these extracts we take our leave of the work, scarcely doubting but what the success of which it is deserving, will be fully extended, when its character and merits become more publicly known among men of science, to whose pursuits it promises to form a most valuable auxiliary.

The Railway Magazine, and Annals of Science. No. XII. New Series. February, 1837. Wyld, Charing-cross.

Among various articles in the present Number of this work, all of which are deserving of the attention of parties interested in railways, more especially at the present time, when Parliament is again called upon to decide between the merits of conflicting lines—there are two by the editor, to which we would direct particular attention.

These are, "On the Commercial Laying Out of Lines of Railway," and on the very natural question, "What will Parliament do with the Railways?" The former of these involves the two important queries:—1st. Is a railway between two given places needful? and, 2d. If constructed, will it pay? The following extract will show the manner in which the subject is treated:—

"In a letter I addressed to the Duke of Wellington in our Sixth Number, p. 223, I suggested—

"That no Bill ought to be permitted to pass, unless it could be clearly shown that the transit could be made in half the time now occupied by the road; and, that the expense of transit, in any case, should not exceed two-thirds of the present expense.

"Was this principle acted on in the Legislature, it would sweep off many of the projects now about to be brought before it; and particularly if the other condition mentioned in the same letter was added, namely—

"That the probable profits to the shareholders shall not be less than ten per cent. per annum.

"If two such cases as these could be fairly established in a line, there certainly could be no objection to granting a Bill. Nay, in the case of profit, if it could be clearly proved, that the existing traffic would grant five per cent. over and above all expenses, the probability is, that a line of railway would pay well. For experience has settled it beyond a doubt, that a reduction of expense and time in travelling, very much increases the amount of it, though it does not yet appear in what proportion. In estimating, however, the traffic, those tricks and frauds which are so often practised on the Legislature, ought to be carefully watched. What right have men to take credit for goods which they know they can never have? Passengers, light goods, perishable articles, and such as require despatch and certainty in delivery, are the proper food of railways; but in weighty articles, not requiring to be speedily delivered, water carriage will probably ever keep the lead. Indeed, from the experiments lately made of the economy in more rapid motions on canals, some think they may ere long contend successfully with railways in the carriage of articles now considered the peculiar property of the latter; but this probably is more the result of sanguine temperament, than of sound reason. Nevertheless, it is quite certain, that to take credit so largely, as is now done, for goods sent by water, is sheer delusion, and far beyond what the results can ever justify.

"Deception is also practised to a very considerable extent in some cases in the estimate of the traffic by land. And this is accomplished by so many little manœuvres, that it would be difficult to enumerate them. On all these accounts it is by no means easy to get at a true state of the facts. Possibly, however, if twenty or thirty-five per cent. was deducted for those untangible exaggerations, it would reduce the statements much nearer the truth; though it must be confessed that there are some who do the thing so cleverly, and maintain their positions with such mendacious gracefulness, that if ninety-nine per cent. was deducted from their statements, the question is, whether the remainder would not still be fifty per cent. too much."

From the latter article we quote the following notice of the Parliamentary contest last session respecting the ever-memorable "Brighton Lines." Words, indeed, can hardly express the unbounded folly and pertinacity with which these rival projects were upheld by their respective partisans:—

"In one of the contests, last year, upwards of 100,000*l.* are said to have been spent, and what was gained? nothing, literally nothing, for all the Bills were thrown out. 'On the Brighton line, alone,' said Mr. Pearson, in an eloquent speech at Brighton, 'there were about twenty counsel engaged, headed by six King's sergeants and King's counsel. There was a regiment of above twenty eminent solicitors of London and Brighton, flanked by a whole brigade of Parliamentary agents [of which Mr. P. himself was one. Who would believe there was so much honesty in the profession?], and a whole array of surveyors and engineers, whose chief business, it appeared to be, to contradict each other [the lawyers aiding and assisting, and chuckling with delight.] To the best of his recollection they were engaged fifty-two days before the Commons, at an expense of 1100*l.* a-day.' Here then upwards of 57,000*l.* was spent in the Commons, all the fruits of which were destroyed by a single vote in the Lords."

Loudon's Magazine of Natural History. New Series. Nos. I. and II. Conducted by Edward Charlesworth, F.G.S. Longman and Co., London.

We have been much gratified, on looking over the two Numbers of this work for January and February, forming the commencement of a new series, conducted by Mr. Charlesworth, whose labours in illustrating the phenomena of our tertiary deposits, especially the Suffolk Crag, we have more than once had occasion to allude to. The matter which it contains must be highly interesting to every cultivator of natural history, while the mode in which the work is got up, and the excellent and spirited wood cuts by which it is illustrated, must confer an additional value upon it.

Among the contributions, we may notice more particularly, a paper on the "Psychological Distinction between Man and all other Animals," by Edward Blyth, Esq.; one on the "Longevity of the Yew, as ascertained from actual Sections of its Trunk, and on the origin of its frequent occurrence in Churchyards," by J. E. Bowman, Esq.; and "Observations upon the *Voluta Lamberti*," and "Description of a Gigantic Species of *Terebratula*, from the Coralline Crag," by the Editor.

The Number for January contains a translation of a very interesting paper in the "*Annales des Sciences Naturelles,*" by M. Deshayes, entitled "An Estimate of the Probable Degree of Temperature in Europe during the Tertiary Periods, founded upon the Study of Fossil Shells." We extract the following passages, as showing the results arrived at by the author.

"From what I have just shown, it appears to me that we may draw the following conclusions:

"1. The first tertiary period took place under an equatorial temperature; and, according to all probability, one many degrees hotter than the present temperature of the equator.

"2. During the second period, the beds of which occupy the centre of Europe, the temperature has been similar to that of Senegal and of Guinea.

"3. The temperature of the third period, at first a little more elevated than ours in the basin of the Mediterranean, has become similar to that which we experience. In the north, the species of the north are fossil; in the south, those of the south.

"Thus, since the commencement of the tertiary strata, the temperature has been constantly diminishing. Passing, in our climates, from the equatorial to that which we now enjoy, it is easy to measure the difference."

M. Deshayes adds, in conclusion—

"Without doubt, naturalists, supporting themselves upon theories concerning heat, have been able to conjecture, *à priori*, the changes of temperature of which I have just spoken: it is curious, nevertheless, to see their conjectures confirmed by a long-neglected science, which no one had yet thought of directing towards this entirely novel end.

"This question respecting temperatures might be resumed for the secondary strata; but observations and materials are wanting. This is not only one in the domain of conchology; many others are of less importance; biology, for example, destined to make us acquainted with the laws of the developement of life on the surface of the earth within time and space, will draw from conchology numerous materials. But biology is a science yet to be formed. Lamarck has discovered it: who shall lay its foundations?"

We cannot take our leave of this work without cordially wishing it that success to which it is entitled, no less by the interesting nature of the subjects treated on, than by the acknowledged abilities of its present Editor, in those departments of science which it embraces.

Discovery of a Roman Bath at Ribchester.—Almost every day brings to light some fresh relict of antiquity at this most ancient place. Mr. R. Patchett, of the Red Lion, being engaged a short time ago in digging, for the purpose of making a hot-bed in his garden, was surprised to discover a spacious Roman bath, being ten yards in length, and five yards in breadth, and the depth four feet. The bottom of the bath was covered with flags, which, with the sides, were covered with a coating of cement. On breaking it up, upwards of forty cart loads of stones were taken away from the place. A silver Festina coin was also found near, and a leaden trough or cistern, about a foot wide and a yard long, and weighing nearly seventy pounds. It will be remembered that some Roman gold coins were lately found at Ribchester, by Mr. John Swarbrick, and we learn that the site of the bath is about 150 yards from the place where these coins were discovered.—*Preston Pilot.*

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. V.

ON THE MANUFACTURE OF WHIM ROPES FROM IRON WIRE.

(Being the Substance of a Communication from Mr. Albert, of Clausthal, Royal Britannic Hanoverian Mining Councillor, to Dr. Karsten, Royal Prussian Privy and Mining Councillor, and Member of the Royal Academy of Sciences in Berlin, Editor of the "Archives of Mineralogy, Mining, Metallurgy," &c.)

[From the "Archiv für Mineralogie, Geognosie, Bergbau und Huttenkunde," conducted by Dr. C. J. B. Karsten. Berlin, 1835.]

The great annual expense of providing ropes for the shafts in the mining district of the Upper Harz, and the circumstance of the hemp being only procurable by importation from abroad, led me during several years to make a series of experiments for the sole application of iron to this purpose. These experiments terminated in new methods of manufacturing whim-ropes, and of obviating their weight, by the adoption of endless chains; but yet my object was not accomplished. However, it occurred to me subsequently, at the commencement of last year (1834), that from wire might be plaited or twisted together so as to form a whim-rope; and the results of my experiments were so completely satisfactory, that arrangements are now making in these mines for the general adoption of ropes of this description. The manufacture of them from iron wire is, in fact, a very simple, and not an expensive operation; and yet there are a great many apparently insignificant circumstances which materially delay the work, and occasion impediments, which can only be obviated by obtaining an accurate knowledge of them. I have, therefore, resolved to describe the process and its peculiarities, and hope thus to render some service to practical science.

In the first place, the iron wire employed is of the sort numbered 12, in the Royal Foundry of the Harz, of the diameter 0,144 inches; and ten feet of the wire weigh 13,91 Loth, Cologne weight, or seven and one-fifth ounces avoirdupois.

This wire is drawn by a machine, in lengths of 60 to 130 feet; and to facilitate the work on the straight-rope course, and to avoid weakening the wire by violent bending, in order to bring it into a straight direction, it is so arranged, that after the last heat, the drawing is performed with a single wire on a cylinder of twelve feet diameter. The price of this wire is at present 9 dollars, 10 groschen current, for 110 lbs. Cologne, or about 1*l.* 7*s.* per cwt.

For the preparation of the wire the following implements are requisite:

1. A large smith's vice, about 70 lbs. in weight, attached to a frame of the usual height.

2. A small hand-vice, about 6 lbs. weight.

3. Iron winches (*fig.* 1), made of one piece, three-eighths of an inch

Fig. 1.

thick at the middle, with round handles at each end, altogether fifteen inches long. The centre forms a flat surface, containing five holes of about three-tenths of an inch diameter. The four outmost holes lie in a circle at one and a quarter inch distant from each other. At the centre of the circle is a similar hole, connected with the other holes by grooves of about one-fifth of an inch in width. This communication may be suspended by means of pegs, introduced through small openings on the narrow side of the winch, pushed before the holes, and fastened by their elasticity, or if required, by grooves made to fit. The holes must have no sharp edges. If dispatch is required, three such winches will be necessary.

4. An iron winch (*fig.* 2) of the same construction as the former, with

Fig. 2.

this difference, that it contains only three holes of half-inch wide, without connexion with each other.

5. About eighty boards, of six inches square, half an inch thick, with four round holes of one-quarter inch wide, two inches apart in the square (*fig.* 3).

Fig. 3.

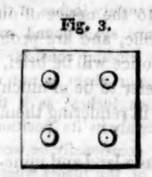
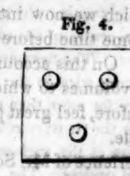


Fig. 4.



6. About ninety similar boards of hard wood, with three round holes of half-inch wide, at equal distances from each other (*fig.* 4).

7. A cast-iron trough one-quarter of an inch thick, three feet long, ten inches wide, eight inches deep, about 60 lbs. in weight, or a similar one of plate iron.

8. Some files for sharpening the ends of the wires, pincers to take off the ends, and pliers to lay on a thin band of wire at particular parts of the chain.

Method of manufacturing the rope.—The work requires a covered walk at least 130 feet long. The wires are laid in a straight line one beside the other, and the ends sharpened with the file before they are applied to the holes. Four wires are fastened to the large vice at the end of the walk, previously to which thirty to forty four-holed boards, and behind them the four-holed winch (No. 3) have been pushed along them, the boards being arranged at the distance of three or four feet from each other, to prevent one wire from touching the other. Along the whole length of the walk, workmen stand at six to ten feet apart, holding the wire up, when trussels or props are not provided, and turning it with a uniform and constant motion. With the length above supposed, about ten persons would be required; although a machine for the purpose is now being made, which will, however, only be advisable when a large number of ropes are to be prepared. At the end of the walk, opposite the vice, a trusty workman is placed, to keep the ends of the wire constantly separate while they are being turned. At the vice two men are stationed; the one turns the iron winch (No. 3) in such a manner, that at every complete revolution of the winch he advances six inches forward. At first this distance may be re-

gulated by measurement, but in a short time practice gives the necessary correctness.

The second workman at the vice follows the turner with the small hand-winch (No. 2), secures in it the twisted rope at every two feet, and holds the winch steady, so that the turner can advance further.

As the turner proceeds, the boards (No. 5) are pushed towards the other end, and the workmen as they reach it successively, are for the time no longer required; as often as the winch is turned once round, so often all the four wires must be turned throughout the whole length of the rope; but during this turning no twisting takes place, but only a motion upwards and downwards, as well as from left to right.

When the turner has proceeded with his work to the end of the walk, and a cord or four wires is thus completed to the above length, this cord, is for the present laid on the ground. The workmen who have been spared, as above described, have meanwhile provided the wires intended for the second cord, with the dividing boards (No. 5), and after them with the second winch (No. 3). The four wires are then inserted in the vice, the turner recommences his work as before; and after that a third cord of four wires is formed by the same process.

It will be requisite to make one of these three cords considerably longer than the others, and the last is preferable for that purpose, as the turning winch (No. 3), and the boards (No. 5) can then be put on at once, so that the turning is not meanwhile delayed. When the three cords of the length of the walk are completed, they are then turned together to form the main rope, the ends of each cord being now put through the ninety boards (No. 6), which are pierced with three holes, the second turning winch with three holes, (No. 4) is put on, and the ends of all the three ropes are at once attached to the main vice (No. 1). The workmen are again distributed along the walk, and the turning proceeds as at first; yet, with this important difference, that as soon as two feet of the rope is turned, the main vice is opened, and the whole of the workmen move two feet forward in that direction, and the finished rope, as it becomes longer, is rolled behind or beside the vice in the form of a coil or ring, at least nine feet in diameter. For this operation a cross is placed on the ground so as to be easily turned round, formed of two strong pieces of deal (*fig.* 5) resting on a pivot in the centre. After com-

Fig. 5.

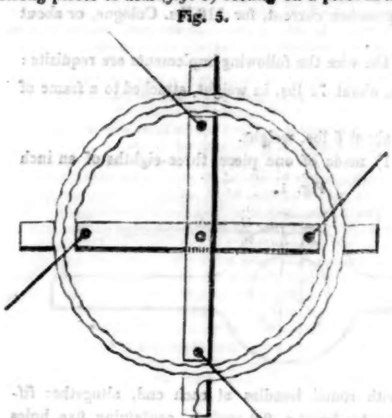


Fig. 6.

pleting thus a rope of three cords and twelve wires, it is lengthened by repeating the same process, when the single wires are to be joined to those of the next rope.

After many trials, I have found it best to unite them by means of friction, in the following manner:—on working to the end of one wire, a new one is inserted into the same holes of the boards, (No. 5) along with it, so that at the ends of the wires which are nearly worked off, two wires always lie together for the length of forty inches. When the turner arrives with the winch (No. 3), at the commencement of a fresh wire, he thrusts it into the centre hole by the sharpened point, and almost into the middle of the four turned strands of the rope in progress, where it is fastened by binding it round a few times with thin wire, mainly for the purpose of ascertaining at any time where the end of a wire is to be found, since it is desirable to bring it, if possible, to the inner part of the main rope, when the latter is to be turned. The rope is then turned twenty inches farther, in such a way that the fresh wire remains firmly seized in the middle of the former. The coresponding peg of the two in the winch (No. 3) is now drawn out, the wire which is nearly worked off is pushed out of its hole in the circle of the winch, and inserted into the centre hole of the same winch; and in its place the forward end of the fresh wire is removed from the centre hole, and inserted into the vacant hole in the circle, when the peg is again pushed forwards.

On continuing the turning, the remaining twenty inches of the old wire likewise occupy the centre of the rope, and are again bound round at the ends with thin wire. The firmness of this binding consists in the circumstance, that every wire in the main rope or chain is not exposed at the exterior surface for more than six to nine inches; as it then enters the interior, where the tension retains it firmly in its position, even although a single wire at the surface should occasionally be worn away or otherwise rendered useless. The marking of the places where the ends are fastened by the thin wire, enables the workman to distribute these fastenings in an equal manner through the rope, which indeed often takes place of itself from the irregular length of the wires, and is often effected by the breaking of the single wires. There should not be more than two ends of different ropes at the same point.

By the method described, a rope of any length may be made, adapted to the depth of any particular shaft. If the covered walk be 130 to 140 feet long, thirteen workmen will be wanted, who may be kept fully employed; of these, five or six must be men in whose care reliance may be placed, the others may be invalids or boys. On an average, these thirteen persons in one hour can finish about fifty feet of rope at least.

The rope when completed must be covered with an adhesive composition, which on cooling still remains *flexible*, in order to defend it against the damp of the mines. For this purpose there may be used the refuse of artificial grease or oily composition; and in default of these, a mixture may be employed, consisting of one-third of oil, and two-thirds of colophorium or resin. The iron trough (No. 8) is filled with this composition, and a coal fire maintained under it till it becomes heated to the temperature of boiling water; the rope is then drawn slowly through it, so that it may become sufficiently heated in the fluid, and till all the interstices become filled with the grease, and consequently devoid of air. In an hour and a half 700 feet may be thus greased by eight workmen. When many ropes are to be made, a machine may be employed for this purpose, which, however, would produce no saving, if the work be on a small scale. To 700 feet of rope, there will be required forty to fifty pounds of the composition.

To join the rope to the chain on which the bucket hangs, I have found the following to be the simplest method:—The end of the rope is heated gently, to the length of eight inches, and then bent round an iron clamp, in the form of the half of a chain link, hollowed from beneath (*fig.* 6). A wrought-iron ring, of one inch in breadth, previously drawn along from the opposite extremity of the rope, is then driven down to the clamp, and the ends of the wires are separately turned through the ring, and fastened or beaten down over it, after which the whole is fastened with wire or strong cord round it; or if greater security is desired, it is enclosed in molten lead. In the grooved clamp a chain-link is suspended before closing the chain, or it may be done afterwards, if a snap-link be employed, which may be opened and shut.

As long as this process presents no manifest disadvantages, it will not be requisite to adopt any superior or more difficult methods. The heated part of the rope should not extend upwards above the ring. After various trials the weight of a rope of 700 feet, without the composition, was found to be only three cwt. one quarter, or three to four pounds every seven feet. The expense, on a close calculation, for manufacturing a rope of 3920 feet, including every outlay, to the time of fixing it to the whim, is 220 dollars, namely, 171 dollars for the wire, and 49 dollars for wages, or about 31*l.* 10s. for the whole, reckoning seven dollars to the pound. Each single wire will bear a tension equal to ten cwt., and the whole twelve, consequently, 120 cwt. The weight of metal used at once is about ten cwt.

It is indispensable that the rope should be coiled within the limits of its elasticity; and, therefore, it is not advisable to have the coils of less diameter than nine feet. The cage of the whims of the shafts in the Harz are in general twelve feet in diameter. The small weight of these ropes, with wheels of twenty-eight to thirty feet diameter, freely admits of the use of buckets from nine to ten feet in height, when, in case of iron chains being employed, only four feet would be allowable with an equal power of the water-wheel. The larger diameter allows, with a slow motion of the wheel, a greater velocity, with advantage to the machine. If every bucket be made of the breadth of three or four feet, the ropes will not wrap or entangle over each otner, even at the depth of 1400 feet or more, by which the injury arising from friction is avoided. The working of these ropes, in reference to the supply of water to the wheel, has proved highly satisfactory, although varying, according to circumstances. At one shaft a saving of one-fourth to one-fifth of the water was the result, as compared with hempen ropes, the work being equal. At another the saving was one-third to two-fifths. In regard to durability and economy, a positive result cannot be given, since none of the wire ropes which have hitherto been in use are yet worn out. At the Caroline shaft, which, on an average, required 3010 feet of fresh hempen rope annually (the total quantity in use being 3640 feet), at a charge of 860 dollars, about 123*l.* sterling; there have now been wire ropes employed thirty-four weeks, which are still perfectly fit for use. So much, however, has already been saved as would suffice to make new ropes. At the present period (April, 1835), ropes of this description are used in four of the principal shafts of the Upper Harz. In a few weeks they will be employed in two shafts more, and they will be gradually adopted, in a manner compatible with a due regard to the interest of those manufacturers who have heretofore supplied the hempen ropes and iron chains. The adoption of the wire rope is a matter of essential importance for the mines of the Upper Harz, where more than 84,000 feet of rope (partly hemp and partly iron) are in constant work, and where every year upwards of 38,500 feet of new rope are required.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.

On Friday, the 17th instant, the anniversary of this society was held, at their apartments in Somerset House.

The President, Mr. Lyell, took the chair at one o'clock, and having read the extracts from the charter and bye-laws relative to the business of the day, the secretaries proceeded to read the reports from the council, and the museum and library committee, as well as from the auditors, on the flourishing state of the accounts for the past year.

The President then communicated to the meeting, that the council had awarded two Wollaston medals, one to Captain Cautley, of the Bengal Artillery, and the other to Dr. Hugh Falconer, of the Bengal Medical Service, for their geological researches and discoveries in Fossil Zoology, in the Sewalik, or Sub-Himalayan range of mountains.

On presenting the medals to Dr. Royle to transmit to his friends in India, the President expressed his conviction, how gratifying it must be to him, to be the medium of communicating to Captain Cautley and Dr. Falconer, the high sense entertained of their services to science by the Geological Society of London, who award these medals as a token of the sympathy they feel for those so zealously labouring in a distant land for the promotion of a common cause. The President further stated, that in his address he would treat more fully of the extent of their labours, and bear testimony to the zeal and industry with which these gentlemen had investigated the structure of the range extending along the southern base of the Himalayan mountains, between the Ganges and Sutledge rivers, as well as to the talent they had displayed in unravelling the anatomical peculiarities of the extinct genus, Sivatherium, and of new species of other generation; and concluded, by requesting that in forwarding these medals, the first sent by the Geological Society to India, that Captain Cautley and Dr. Falconer should be assured of the unabated interest which the society take in their researches, together with ardent hopes for their future welfare and success.

Dr. Royle, in reply, said he did feel high gratification at being made the medium of transmitting to India the distinguished honours conferred by the Geological Society on his friends, Captain Cautley and Dr. Falconer, as he could himself bear testimony to the zeal which animated those gentlemen in the prosecution of geological researches. Having had opened to their investigations one of the most extensive deposits of fossil remains, and being without books, without museum, or the aid of skilful naturalists, they had, undeterred by difficulties, proceeded to the examination of extinct forms, by making a museum of the skeletons of the animals existing in the forests, the rivers, and the mountains of northern India. By these means they had come to decisions which have been approved of by anatomists, both of London and Paris. He expressed also his assurance that the approbation of the Geological Society would not only stimulate them to fresh exertions, but excite others to follow their example.

Thanks were then voted to the retiring President, Mr. Lyell, and members of the council, Sir Alexander Crichton, M.D., W. J. Hamilton, Esq., Viscount Oxmantown, and Lieut.-Col. Sykes.

On proposing the thanks of the Society to Sir Philip Egerton, retiring from the office of Vice-President, Mr. Whewell alluded to the loss just sustained by the Society in the lamented decease of Dr. Turner, who had also been one of the Vice-Presidents. He could not trust himself, so recent had been the event, to express his feelings; but he was convinced that it was not necessary to allude to the high scientific attainment of their deceased Vice-President and friend, or to remind the Society of the high moral excellencies of Dr. Turner.

The Scrutineers having examined the balloting glasses, then reported that the following gentlemen had been elected the officers and council for the ensuing year,—President: Rev. Wm. Whewell. Vice-Presidents: Rev. Wm. Buckland, D.D.; William Henry Fitton, M.D.; George Bellas Greenough, Esq.; Roderick Impey Murchison, Esq. Secretaries Robert Hutton, Esq.; Professor Royle, M.D. Foreign Secretary: H. T. De la Beche, Esq. Treasurer: John Taylor Esq. Council: F. Baily, Esq; W. J. Broderip, Esq.; W. Clift, Esq.; Viscount Cole, M.D.; Charles Darwin, Esq.; Professor Daubeny, M.D.; Sir P. Grey Egerton, Bart, M.P.; H. Hallam, Esq.; Leonard Horner Esq.; C. Lyell, junr., Esq.; Marquis of Northampton; W. Parish, junr., Esq.; Rev. Professor Sedgwick; Henry Warburton, Esq., M.P.

During the meeting in the morning, and at that in the evening, Mr. Lyell delivered the annual address, in which he took notice of the labours of those Fellows which the Society had lost during the year 1836; as well as of the memoirs which had been read, and in the progress which the science has made since the last anniversary.

GEOLOGY.

An admirable introductory Lecture on Geology was recently delivered by J. B. Jukes, Esq., F.G.S., at the Mechanics' Institution, Wolverhampton. Mr. Jukes gave a brief, but extremely clear and interesting history of the science, and of the various theories of its earlier professors; and then sketched out, in a concise but forcible manner, the chief facts which form the basis of modern geology. This sketch, it appears, he is now further elucidating, by a more extended review of the subject in his present course. A few disjointed extracts from the single lecture, are all we have at present either space or opportunity to offer to our readers; but these will be interesting, even to the most unscientific persons.

"The mental faculties of man, equally with his bodily ones, are so constituted that exercise and activity is a necessary part of their very nature and object. We cannot help inquiring into the reasons and causes of the things we see around us; or if, as is often the case, custom should blunt the edge of appetite, and familiar things from their very familiarity remain neglected, any thing novel or unexpected instantly sets to work the faculty of curiosity, and we feel an ardent desire to become acquainted with the cause and nature of the object which has excited it. From this faculty—this impulse of investigation and desire of knowledge—all human learning, and, in a more especial manner, all the sciences, derive their origin. There are, however, two methods of scientific investigation. By the one, a man having his curiosity excited by any thing which seems to him extraordinary, goes and shuts himself up in his study, and endeavours to hammer out a reason for it, or at least to frame some hypothetical theory which shall explain it; and, having constructed that, blindly adheres to it, clings to the intellectual fetters he has himself forged, and endeavours to bend every thing under the same subjection. He first of all forms his theory, and then looks out for facts to support it. By the other method, however, not satisfied with the bare knowledge of the single fact in question, the enquirer goes on to trace its connexion with others, to learn all the relations between this object and those which may be associated with it; in shor:, to have a full and commanding view of the whole subject, before he attempts to explain it. He founds his theory solely on the previous knowledge of his facts. Now, however obvious this latter course may be, it is odd that it is always the last one taken. Mankind were content to dream on in absurd speculations upon things which they did not give themselves the trouble to examine, till Bacon arose and set them in the right path, by founding what is called the experimental Philosophy. It is, however, astonishing to find how much of the desire to decide upon questions without understanding their merits, or to jump to conclusions before investigating premises still remains. And this has been, and still is, most especially the case with the science of Geology * * * * * * *

"It is not now more than twenty-five years since the science itself has been pursued at all under the rules or guidance of the true philosophy, as we shall see by glancing over its early history. If we look out upon this beautiful world, we may, perhaps, admire the richness of its plains, the beauty of its valleys, or the magnificence of its lofty hills; and the question might possibly occur to us, 'Have these been always thus? Have these hills, and plains, and valleys, the same form now as when fresh from the hands of the Creator?' Who or what can tell us? Struck with the magnitude of the question, it haunts our minds, till, in our daily walks and rambles, we are insensibly on the look-out for something which may tend to its solution; and it is not long before we perceive that many of the solid masses of the earth are full of bodies which bear a strong resemblance to sea-shells, except that, for the most part, their substance is no longer shelly, but hard and stony. Whence have they been derived? Pursuing our investigations, we find more and yet more of these apparent products of the sea, till, in a bed of sand or gravel, on the summit of some hill, perhaps we find shells unaltered from their original appearance, when inhabitants of the deep. We can now no longer refuse to believe the, at first astonishing, fact, that the sea has once rested upon what are now the summits of the loftiest hills. Accordingly in the earliest times, we find this fact admitted, and alluded to by various ancient writers.

"Mr. Jukes then adverted to the theories of the early Italian naturalists, and those of Leibnitz, Hooke, Ray, Woodward, Burnett, and Whiston, the two latter of whom composed theories of the earth, which have been aptly designated philosophical romances, in which earth and ocean are the principal characters, and comets are called in to extricate them from their difficulties. Buffon, Werner, and Hutton next appeared; the two latter forming the long-opposing Neptunian and Volcanian sects in science. The controversy between them raged for some time, in a manner unexampled in the annals of philosophy; till a new school arose, which, declaring itself strictly neutral, and devoting itself to the collection of facts only, without espousing any theory not absolutely warranted by them, succeeded, at length, in effecting a compromise between the contending parties, and the memory of the contest now alone remains, to serve as a warning for the future against all such absurd and useless enlistment of the bitterness of party spirit into the sober discussions of natural philosophy. In treating of the varieties of rocks and organic remains. Mr. Jukes observed—England, indeed, is a complete geological cabinet, where the fossil and the phenomena which, in other countries, must be sought far and wide, are here nicely packed up, as it were, and arranged for examination. * * * * *

"A remarkable fact connected with the whole series of stratified rocks, is this, that in all the great abundance they contain of the remains of creatures that once lived and died upon the earth, there is not to be found a trace of the existence of man. Not a fragment of his bones, not a flint hatchet, nor a bit of hewn wood can be discovered, even in the newest of the tertiary strata. This circumstance goes far to prove that the whole of the operations of which we have hitherto been speaking, took place long anterior to the creation and existence of man upon the globe. In some formations in progress at the present day, as on the coast of Guadaloupe, in a rock known to be forming daily, we do find human skeletons. If then, man had existed during the formation of the stratified rocks, some traces of him would be discoverable in them, and the entire absence of all such traces unquestionably proves, that during the whole period of time occupied by the deposition of these strata, man had not begun to be a denizen of earth. Here is a lesson which should, indeed, teach us humility. We are apt, in our arrogance and presumption, to look down upon the earth, and the races of animals it contains, as created solely with a view to our pleasure and convenience. We measure the worth and goodness of all terrestrial things by the degrees in which they conduce to our immediate benefit: their profit to us we make the standard of their utility in the scale of creation. But geology unfolds to us far different views; it tells us of races of animals which lived, and moved, and had their being, throughout long ages, when the foot of man had never trod upon the earth. And if, as is apparent, many of the present stages which earth has passed through since its creation, were arranged with a prospective view to the habitation of it by man, it is equally apparent that that arrangement embraced also the happiness and welfare of numberless other creatures, with whose existence man's had not one link in common. Are, then, or are not the views and instructions given to us by geology in accordance with those we obtain from the study of the other works of the Creator's hand? By this test must the science stand or fall. It is impossible that any of the works which proceed from an all-wise and all-powerful Creator can be otherwise than in the strictest and closest harmony. It is incumbent, then, upon a geologist to prove that, in his science, there is no jarring note which can tend to produce a discord.—*Birmingham Herald.*

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The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT---XIII.

REVIEWS.

Transactions of the Geological Society of London. Second Series. Volume IV., Part the Second. London, 1836. Published at the Apartments of the Geological Society, Somerset House.

[*Concluded from page 46.*]

Germany will ever be considered as the classic ground of geology; it was from the school of Freyberg that Humboldt and other distinguished men first issued forth to explore the structure of the earth in its remotest regions—their minds glowing with the enthusiasm which Werner was so successful in communicating to his pupils—and anxiously bent on realising and confirming the beautiful, but shadowy and premature, generalisations which he had blended with the infant science. It is in Germany that the original types of most of our rock formations are found—from that country our mineralogical and geological nomenclature is in some measure derived; and from German authors much of our knowledge on these subjects was, in the first instance, obtained.

With reflections such as these, we turn with peculiar interest to the concluding paper in the present volume of the Geological Society's Transactions—that by Mr. Leonard Horner, on the "Geology of the Environs of Bonn." This paper illustrates the structure of one of the most picturesque and interesting portions of Germany, including the "Castled Crag of Drachenfels," the romantic "Seven Mountains," with the majestic Rhine flowing beneath them, and the fertile wide-extended plain, on which stands the pleasant city of Bonn. Rising abruptly from this plain, which is chiefly composed of tertiary formations, and following the course of the Rhine, extends northward into Holland, the "Seven Mountains," with their dependencies, constitute an object no less interesting to the geologist than to the admirer of picturesque scenery. We remember gazing with admiration on their graceful and varying outline, when, passing up the Rhine, they first met our view, and relieved the former monotony of the level country, which before encircled its banks. The form and general aspect of these mountains struck us as much resembling the Malvern Hills of Worcestershire, but more rugged and abrupt, and rendered doubly picturesque by the noble river which flows along at their base.

The "Siebengebirge," or Seven Mountains, form a portion of that extinct volcanic group which borders on the Rhine, to the eastward, in the vicinity of Bonn, Andernach, and Coblentz, presenting a great variety of basaltic, trachytic, and other pyrogenous rocks, in addition to lavas and ordinary volcanic productions. A similar group (or rather an extension of the same), on the opposite side of the Rhine, constitutes the well-known "Eifel" district, of which an interesting account was given in one of the "Foreign Extracts," which appeared in our Supplement some time since, and to which we may refer the reader who is desirous of becoming acquainted with the phenomena of extinct volcanos—one of the few which we have no opportunity of studying within the limits of our own country.

The plains which we have before noticed as bordering on these volcanic mountains to the north, also present many objects of much interest to the geologist, among which may be named the remarkable deposit, termed the "loess," and also the "brown coal" formation, which much resembles the lignite occurring in Devonshire, and termed, from its locality, "Bovey coal." The various objects above-named, Mr. Horner has possessed every facility of studying, during a residence of several years at Bonn, and with the result of his observations, combined with that of other geologists, we are made acquainted in the paper before us, which is accompanied by a geological map and other illustrations.

That this task has been ably performed, it is hardly necessary for us to observe, and we now proceed to make such extracts as may be best calculated to interest our readers, and give them a general idea of the most important geological features in the district under consideration. The "Seven Mountains" are thus described, at the commencement of the paper:—

"The Siebengebirge, or Seven Mountains, are the grand feature in the district, and constitute a group of hills, of very graceful forms, on the right bank of the river. Looking down from one of their higher summits, one sees a numerous assemblage of conical hills and connecting ridges; but when viewed from a distance, and in certain positions, seven peaks rise conspicuously above the rest, and hence the group has received its name. Of these the most remarkable, as well from its individual form as from its fame in legendary story, is the Drachenfels, with a ruined castle on its summit. But the Oelberg is the highest point, being 1369 English feet above the level of the sea, or 1209 above the Rhine, the surface of which at Königswinter, a small town at the foot of the Drachenfels, is, at its mean height, 160 feet above the sea."

To the geological student who may be anxious to avail himself of the opportunities which this district presents, of studying the phenomena of extinct volcanic action, the following information will be acceptable:—

"But to the geologists of England this remarkable district is little known; it is, however, particularly deserving of their attention, for, diversified as is the mineral structure of the British isles, nothing analogous to it occurs in them; and it affords this further attraction, that the Siebengebirge and the neighbouring country of the Eifel are the nearest points to England where volcanic phenomena, in all approaching in character to those of modern times, can be seen. Those who are desirous of studying, on the spot, the effects of volcanic action, by availing themselves of the facilities of steam navigation, may, with great ease, in six days from leaving London, reach the Siebengebirge in the Upper Eifel, and there study by the side of a stream of lava, which the fires have been long extinguished, on the edge of a crater covered with cinders. Nor is it to be forgotten, that these numerous objects of geological interest present themselves in a country renowned for the charms of its natural scenery and historical associations."

On the general structure of this district, Mr. Horner makes the following remarks:—

"The lowest and the prevailing sedimentary deposit of the district is grauwacke, both in the form of sandstone and of slate, a continuation of the same formation which covers so great an extent of country in the Lower Rhine, and in the Eifel; but here no limestone beds are associated with it. None of the latter secondary strata occur, and the grauwacke is covered unconformably by a deposit of the tertiary period, consisting of a series of beds of sand, sandstones, clays, and lignites, which collectively constitute a brown coal formation. This is covered by an extensive bed of gravel, and above the gravel is a loosely coherent sandy loam, containing terrestrial and aquatic shells of existing species, called in the Rhine valley by the technical name of *Loess*. From under the grauwacke a variety of unstratified rocks have been erupted, consisting of various kinds of trachyte and trachyte tuff, basalt, dolerite, and other modifications of trap; and in one place volcanic scoriae. The main body of the Siebengebirge is composed of these unstratified rocks."

The grauwacke formation, as will be seen from the preceding extract, prevails very extensively in this part of Germany, and forms many of the abrupt eminences bordering on the Rhine. The general character of this rock is thus described:—

"*Grauwacke.*—This rock varies considerably in mineral character, sometimes occurring as a fine-grained clay slate, not distinguishable from that of Westmoreland; in others, as a coarse red sandstone, very like some beds of the old red sandstone of Herefordshire and Shropshire. Although I found no opportunities of forming a decided opinion on the subject, it is probable that the prevailing rock in the neighbourhood of the Siebengebirge belongs to the later periods of the grauwacke deposit. At Dottendorf, on the left bank of the Rhine, about two miles from Bonn, there are beds of it of a loose texture, containing rounded pebbles of slate, with numerous vegetable impressions, which, in specimens, might be taken for a sandstone of the coal-measures. These impressions are too indistinct in form to enable one to pronounce upon their nature; they are black, and when exposed to heat, the blackness disappears. Impressions of Terebratulæ and the stalks of Encrinites, although abundant in the grauwacke of the adjoining country, are not very common within this district. They are found in that near Rhöndorf, and in the neighbourhood of Unkel. In some places it contains anthracite; and I was informed by Mr. A. L. Sack, that at Bruckhausen six different beds of it were found, one of which was a foot thick, but they were not continuous.

"The strata are generally highly inclined, but they are found at all angles. There is neither uniformity in the strike nor in the dip, but the former is most generally from north-east to south-west, and the dip more frequently south than north. In the immediate neighbourhood of the Siebengebirge the strata are thrown up in all directions, which, at first sight, might be thought to be caused by the eruption of the volcanic matter; but there are great derangements of the grauwacke in the Eifel and Westerwald, at a distance from igneous rocks. Sudden variations in the strike and dip, the latter from vertical to horizontal (if I may so speak of dip), may be well observed between Unkel quarry and Remagen, and on the opposite side of the Rhine, between Erpel and Orsberg."

Basaltic rocks are very abundant in many parts of the district, and occupy large portions of the adjoining Duchy of Nassau, where we have observed fine specimens of the columnar varieties, often indeed applied to the use of posts in the towns and by the road sides—a purpose for which the form and dimensions of the columns are peculiarly adapted. Mr. Horner furnishes the following interesting particulars relative to the structure and uses of this rock:—

"The most regular columns are pentagons and hexagons; in these the angles are very sharp. It is a very compact black basalt, which breaks into very sharp fragments that ring like glass, and contains few imbedded minerals: I obtained, however, a good specimen of slender prismatic mesotype. The ends of the columns reach the surface, and are not covered by amorphous basalt; but they are an inferior bed, for higher up, at the very summit, there is a mass of columns less regular in form, lying in an inclined position, and detached from each other. Such is the profusion of basaltic columns in this neighbourhood, that the walls of the town of Linz are wholly built of them, laid on their sides, with the ends projecting outwards; and the streets are paved with the smaller columns set on end, a miniature representation of the Giant's Causeway. The walls of Bonn and Cologne are in the same way built of fragments of basaltic columns, laid with brick; and the posts by the sides of the roads and streets in this part of the country are generally made of the same ready-shaped stones."

In our own country, where the carboniferous series is so largely developed, the deposits of lignite, which occur in many parts of our secondary formations, are of little importance, in an economical point of view. In some parts of Germany and the continent, however, the case is very different, and, in the absence of bituminous coal, lignite becomes an article of considerable importance, furnishing the chief fuel of the district in which it occurs. Mr. Horner gives the following account of the "brown coal" formation, which extends over large portions of the plain on which Bonn and Cologne are situated:—

"*Brown-Coal Formation.*—This formation consists of an assemblage of beds of siliceous sand, sandstone, quartzose, conglomerate, clay of different qualities, clay ironstone in layers and detached masses in the clay, and of lignite of various qualities, in distinct beds, and intermixed with the clay.

"It occupies a great extent of country on both sides of the Rhine. On the right bank it covers the northern slope of the Siebengebirge, as it falls to the plain through which the Sieg flows, occupying an area of about seven miles from east to west, and five from north to south. It occurs again north of the Sieg, in detached spots along the sides of the hills forming the eastern boundary of the Rhine valley, as far as the immediate vicinity of Bensberg, nine miles east of Cologne. On the left bank of the river it forms a long broad ridge of low hills, or rather plateau, lying between the valleys of the Rhine and the Erft, from the town of Meckenheim, nine miles south-west of Bonn, to the south of the town of Bergheim, between Cologne and Juliers, a stretch of about thirty miles; and Professor Nöggerath informs me that he has traced the lignite beds at intervals from Bergheim to Aix la Chapelle. The breadth of the plateau varies from three to five miles. It greatest elevation is about 200 feet above the plain on the eastern side; and from the foot of the plateau, near Brühl, to the Rhine, a distance of about five miles, there is a fall of fifty feet. These two districts, on the right and left banks of the Rhine, are the chief deposits; but the formation occurs at several places further south, on both sides of the river, and also *within* the volcanic regions of the Siebengebirge and Lower Eifel."

The nature of the "brown coal" itself, is more particularly described in the following extract:—

"*The Brown-Coal or Lignite.*—This is found in various states:—

"A dark brown or black earthy substance, friable, sometimes pulverulent, generally occupying the upper part of the lignite beds, and rarely showing a stratified structure.

"A concreted mass, in which fragments of wood and leaves are visible, with a mixture of earthy matter.

"Wood in different stages of bituminization, of all shades of colour, from light brown to black, and the latter sometimes approaching to the nature of jet.

"Papierkohle, highly bituminous, burning with a bright flame, leaving a white ash, separating readily into leaves as thin as writing-paper; a deposit of finely comminuted vegetable matter and earth.

"The wood is generally in fragments of inconsiderable size; but sometimes large stems of trees are found, and if lying horizontal, as they usually are, very often flattened. Trees have been met with in an upright position, with their roots attached, and the stem passing through different beds, into which the lignite deposit is separable. Professor Nöggerath mentions two instances at Friesdorf; in the one the tree was seven feet in diameter, and from the beds it penetrated must have been about ten feet high; in the other the tree was eleven feet thick, but how high could not be ascertained. At Zisselsmaar, on the western side of the plateau, an upright mass of root and stem, of four feet in length, was found. I do not, however, mention these instances as any proof of the trees being in the situation in which they grew, for if they were floated, the heavy root might keep them in an erect position, and the rarity of the occurrence is a strong presumption against the idea.

"The wood is sometimes so fresh, so little changed, as to have been used at Vlernich for timbers in the mines. Pyrites is of frequent occurrence in all the beds; and sometimes, as at Friesdorf and Holtorf, wood, in which the texture is preserved, is highly charged with a granular carbonate of iron. A specimen which accompanies this paper is a portion of a tree which I found in a thick bed of lignite at Friesdorf; it was about four feet long and a foot and a half in diameter. The interior was converted into carbonate of iron, to the almost total disappearance of the woody texture, but this last was still entire on the outside, where the iron was in the state of a yellow oxide. I have mentioned, that I found a portion of wood highly charged with oxide of iron in the basaltic tuff of Siegberg; and it is important to remark, with reference to the relative age of the brown-coal formation, and the volcanic eruption of Siegburg, that, in addition to this fact, I found a specimen of bituminized wood in the basaltic tuff, identical in appearance with a specimen which I obtained from the brown-coal beds at Giesteinger Busch.

"M. Von Dechen mentions that at Lieblar a lignite is found with a thin powdery coating of amber. From the smell which this coal gives out when burnt, the workmen call it *edeler Weihrauch*, frankincense."

The remarkable deposit peculiar to the valley of the Rhine, called the "loess," is thus described by Mr. Horner:—

"*Loess.*—The substance to which this name is applied is a sandy calcareous loam of a yellowish brown colour, slightly coherent, and absorbing water with great avidity. It is a deposit which has been generally considered to be peculiar to the Rhine valley, and it is found, to a great extent, at detached points on both sides of the river, from Basle to Bonn. It has not been noticed by previous writers on the district described in this paper with that attention to which its geological importance entitles it. Loess is specially noticed by Leonhard in his *Charakteristik der Felsarten*, published in 1824, who has adopted this trivial name, given to it in the neighbourhood of Basle; but a fuller account of it has more recently been given by Professor Bronn, in his description of the environs of Heidelberg, and from which I have put together the following particulars.

"It is found on the side of the hills next the Rhine valley, and penetrating into the side valleys, such as that of the Neckar, Mayn, and Lahn, and occurs chiefly in those situations where the form of the land presented a barrier against its being washed away by a descending stream. It is, for example, more abundant near Worms and Oppenheim than near Heidelberg, because the force of the Rhine is chiefly directed there against its right bank. It is found at various distances from the plain of the Rhine, as much as nine miles, and it is in some places 600 feet above the level of the sea.

"One hundred parts of that near Heidelberg yielded fifty per cent. of siliceous sand, sixteen and a half of argillaceous earth, nearly thirty-two of carbonate of lime, a trace of magnesia, and it was coloured by iron and manganese.

"In the immediate vicinity of the primary mountains it has a somewhat different character, being more sandy, and containing mica.

"The loess does not contain what can properly be called petrifactions, but a vast number of calcined land-shells of living species, more usually in the upper than in the lower parts of the deposit, and they seem to belong to particular horizontal beds. There have been found near Heidelberg the following species: *Helix pomatia, H. nemoralis, H. hortensis, H. hispida, H. ericetorum, Bulimus radiatus, B. lubricus, Lymneus ovatus.* Some years ago, the lower part of an elephant's tusk was found near Weinheim, at an elevation of 100 feet above the Rhine, and some fragments of elephants' grinders had been previously found at a little distance from the same spot.

"It is found lying on granite, porphyry, red sandstone, muschelkalk, keuper, and lias, and near Oppenheim on grobkalk (calcaire grossier)."

From Mr. Horner's remarks "On the relative ages of the Volcanic Rocks to each other, and to the Sedimentary Rocks," we make the following extract:—

"All these facts seem to me to prove that volcanic eruptions were going on in a freshwater lake, in the same manner as we have submarine eruptions at the present day, during the time that the brown coal beds were in the course of being deposited. It is probable, however, that all the volcanic rocks we now see were not ejected at that period, but that subsequent eruptions took place which heaved up the Siebengebirge, and the cones to the south, carrying up the brown coal beds along with them, in some instances, as at Stösschen, to the height of 900 feet above the present surface of the Rhine; the same action, probably, heaving up the plateau on the left bank of the river, although with a less degree of force, as the basaltic outbursts on that side are comparatively on a limited scale. The great fault in the brown coal beds indicates a powerful and sudden disturbing force. It would appear, also, that the great mass of gravel which covers the brown-coal beds had been strewed over them previous to this elevation, for it is found on both sides of the Rhine at a great height, and never in the intermediate plain, the gravel of which, as far as my observations go, has quite a distinct character."

Our lengthened notice, and the copious extracts made from the work before us, leave little room for further remark. Like all the preceding volumes of the Geological Society's Transactions, it contains much and varied information on many subjects of geological investigation, written by gentlemen who deservedly occupy the highest rank in this department of science. Were we to find any subject for regret, it would arise from the long interval elapsing between the reading and publication of the papers contained—a circumstance rendering an appendix necessary to two of the papers in the present volume. This, however, it is perhaps difficult wholly to avoid in a rapidly progressing science like geology, although we think it deserving of the attention of those under whose direction the Transactions are published.

The American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL. D., &c. &c. Vols. XXX. and XXXI. (for the year 1836). New Haven, Maltby, Herrick, and Noyes.

The "American Journal of Science," is a work which we always receive with pleasure, and which well repays our perusal. We view with interest the proceedings of our fellow-labourers on the other side of the Atlantic, and their researches are continually opening to us a most valuable supplement to the labours of European philosophers. The vast expanse of territory belonging to the various States of what has been emphatically termed, the "New World," is as yet very imperfectly explored, and to the geologist, the mineralogist, and the naturalist, is thus continually presenting new facts for observation, and new data for generalization.

Professor Silliman's "American Journal of Science and Arts," is valuable, not less for the ability with which it is conducted, than as being the principal medium of communication both between men of science in that country with each other, and with their European brethren. The volumes before us contain much which does not, strictly speaking, fall under the denomination of science; the matter thus interspersed is, however, of an interesting nature, and highly characteristic both of the past and present state of that mighty empire in the western hemisphere, which has had its origin in the naval enterprise and the turbulent politics of Great Britain.

We had marked several passages for extract, but the following one, from a paper on the "Transition Rocks of the Cataraqui," by Captain R. H. Bonnycastle, is all that our space at present allows, and we shall, therefore, take an early opportunity of returning to Professor Silliman's work.

"Limestone of so very ancient a class, being formed into prismatic shapes"

so similarly to basalt, but taking a nearly horizontal position, presents a new feature in geology, and although at first sight, it might go far to prove the theories which have been advanced concerning the igneous origin of the Cataraqui rocks in its vicinity, yet on a more careful examination of them, it does not appear to justify those theories, or to cause me to waver from the opinion originally given, that the Cataraqui granitic rocks are of an age assimilating to the transition limestone, with which they are so closely connected, and the singular appearance this lithographic limestone has here assumed, in a limited locality, may be traced satisfactorily to the same causes which have made the greenstone of Lake Superior associated with sienite, to assume the columnar form, which is at Kingston, after all, perhaps, merely a modification of cleavage on a grand scale, or a mere deviation from ordinary appearances, similar to the beautiful minute columnar limestone of the adjacent beds, which we have already described, and which may as well be brought forward, to testify that these enormously thick masses of horizontal fossiliferous rock owed their origin to volcanic agency.

"In fact, I see nothing, after several years experience, to alter the opinions which have been assumed by the geologists already adverted to, that these are granitic rocks of the families posterior to the primary class, and I think that these opinions are very strongly assisted and developed in Upper Canada, from the extremity of Lake Superior to the shores of the United States, near the Thousand Islands of the St. Lawrence; and in further investigating this very interesting subject, I shall hereafter endeavour to undertake a description of the *Lacustrian* chain, under which term is embraced the ridge which bounds Superior, Huron, and the ancient shores of Ontario, and endeavour to prove that the primary rocks scarcely exist in this chain, which appears to me to be of a much more recent date than that class, and to have owed its origin to the same influence which formed the transition rocks of the Cataraqui, and has been but little affected by that igneous agency which created the decided trappose masses occasionally blended with it; and I am the more inclined to support this opinion, from the absence of mica, either schistose, or forming a considerable share of ingredients in the granitic aggregates of this immensely long chain, which strikes across the St. Lawrence, and is split into the Thousand Islands, before it sweeps onward towards the Rocky Mountains, the true Andes of North America.

"The want of altitude in the Lacustrian chain is very remarkable, until it reaches Lake Superior, where the transition limestones are not so observable, and where igneous agency is more apparent.

"It is well known that the greater portion of the United States and of Canada, is decidedly, either of the transition or secondary class, and that the beds of these rocks are there of enormous thickness, and are either very little elevated above the ocean, or in many places below its level; whilst the primary rocks are comparatively of little extent in those regions and never lofty.

"If it be true, therefore, as Bakewell has ingeniously advanced, that volcanic action does not always (and perhaps it never does) take place in what we have hitherto considered the lowest rock formation or granite; and from what an inconceivable depth must that action have originated in this vast tract of country, and how likely that it formed the low ridges of the Lacustrian range, by a partial upheaving of the older transition rocks, which it occasionally pierced through, and what extraordinary power must have been exerted where it has fractured the granite and its superincumbent beds, to eject and form recognised trap.

"Bakewell observes, that in Auvergne and a large part of Central France, granite is the foundation rock, and that it has been pierced through by numerous ancient volcanoes, which have poured currents of lava over its surface, and covered other parts with loose scoria and black volcanic sand, some of the currents of lava appearing as fresh as the recent ones from Etna or Vesuvius. In other parts of Auvergne, he thinks only, that the granite has been acted upon by subterraneous fire in situ, and in some mountains, as in the Pay de Chopine, near Rione, granite and volcanic rocks are intermixed, one part being true granite, and the other volcanic porphyry, or trachyte, and this is also the case on Lake Superior.

"Where the seat of the igneous agency is very deep, as it no doubt is in the enormous basin of North America, and covered by the primary rocks and their superincumbent masses, it would be not at all unlikely, that in travelling to find a vent for the pent up gases, it would upheave, and finally crack long tortuous lines, spending the utmost of its force, wherever it formed spiracles by which to eject its confined vapours.

"These spiracles, no doubt, in the case of the Canadas, must be sought for to the westward of Lake Superior, and to the eastward of the St. Lawrence, and hence the wild and disjointed masses which create such a display of magnificent scenes on the northern coasts of Superior, and on the borders of the Gulf of St. Lawrence, in Labrador and Gaspesia, whilst all the intervening country, from Quebec to Huron, is tame and level, with the exception of the Lacustrian chain, and a few isolated trappose mounds, as those at and near Montreal.

"Earthquake, even in our own days, exerts its influence on part of this line near the *Saguenay*, where the appropriate names of *Mal Baie* and *Les Eboulemens* testify its best known localities. Whether similar phenomena occur in the northern region of Superior or not, cannot easily be ascertained, as that country, from the broken nature of its surface, is a complete desert even to the Indians, who are unable to exist in it.

"The nature of the shocks in the Saguenay country has been subjected to as much investigation as a territory so thinly inhabited, and so rarely visited by men of research, could afford proper opportunites for, but it has been ascertained beyond doubt, that at Mal Baie, their direction is easterly, or proceeding to the convulsed line of the Gaspé country. A singular noise, like the roaring of a chimney on fire, precedes them, accompanied by distinct concussions; and there is very little reason to disbelieve the assertion of the natives and settlers, that an actual volcanic eruption has happened within the memory of man, in the unexplored back country.

"It would be very interesting to trace minutely the connexion of the volcanic rocks in Lower Canada and Labrador, where there are most interesting facts to be studied regarding the formation, denominated trappose, and the singular columnar basalt of Castle Reef rock in Henley Harbor, on the Labrador coast; it merits that observation, which we trust Captain Bayfield has given to it, should his survey of the Gulf have yet extended there; for, although, on a smaller scale, it appears, by the description given of it in the first volume of the "Quebec Transactions," to be equally interesting with the similar formations of Staffa, and the north coast of Ireland, and that there are several caves in its vicinity, which indicate that it may extend over a much larger tract of country, than has hitherto been noticed. The columns there are stated to be verticle, extending in circumference from two to seven or eight feet, and jointed by the cup-shaped sockets at every foot or eighteen inches; their number of sides varying from pentagonal to the hexagon, heptagon, and octagon, whilst their height reaches to twenty-five feet at one place, where they support an enormous roof or cap of amorphous basalt, fifty feet in thickness, resembling an irregular fortification.

"The explored course of this basaltic formation was from east to west, and the columns to the westward were of greater magnitude than those to the eastward.

"That Canada has been subject to the influence of earthquakes, there can be no doubt, not only from the configuration of the country, but from actual observation.

"The greatest convulsion on record, was that mentioned by the Jesuits, as having occurred in 1663, which lasted six months, or from January to July, overturning mountains, altering the course of rivers, and rendering the mighty St. Lawrence white. Such an event too (probably), from the direction that river takes, created its present channel, and particularly on the Niagara Frontier, where the mural precipices of sandstone and shale, seem to have been formed by the rending of the rocks asunder into a vast longitudinal fissure.

"At Mal Baie and the country adjacent, it appears that since 1663, the inhabitants have noticed that a recurrence of this dreadful visitation in its greatest vigour, occurs periodically once in twenty-five years, lasting about forty days at each return; these exact periods are probably not accurately defined. The greatest shocks felt of late years, were in 1791, which date is, however, within the calculation, as it embraces the fifth quarter century from 1653. I had at one time thought that the phenomena of the dark days of Lower Canada might be ascribed to this influence, but the recorded dates do not agree, for 1785 and 1814 do not come within the quarter centuries, although neither are far from them. Charlevoix observes, that it rained ashes for six hours at the mouth of the Saguenay in 1663, and there were such clouds of light dust, resembling smoke, that an universal conflagration was dreaded. This looks as though the grand outlet of the gases in the earthquake of 1663 was near Mal Baie, where perhaps, or in Labrador, an active volcano will yet be found.

"But, well established as the circumstances connected with the Saguenay country may ever be, in the case of the *Lacustrian* range, the outlets for the gases must be sought for either in the Rocky Mountains, or in the unexplored countries between the Canadas and the Arctic Ocean. The Indians assert that there is an active volcano in the interior, behind the settled ranges of townships on the northern shore of the St. Lawrence, and a crater of a small extinct volcano is marked on the Upper Canada maps, in the township of Mulmur, near that elevated range called the Blue Mountains, which border the shores of Lake Huron in Nottawasaga Bay, from Cabot's Head to the termination of that vast gulf.

"These mountains, which from a distant view I obtained of them last summer, are the highest land in those parts of Upper Canada yet laid out for settlement, and will, I have no doubt, when examined, prove to be a spar of that chain which runs along the opposite coast of Huron, and is connected with the Rocky Mountains on one side, and with the Atlantic, through the Thousand Islands of the St. Lawrence on the other.

"That vast tracts of country have been upheaved, even in our own times, is well known, and that the continued action of volcanic fires exists at an immense depth, in given directions, is also clearly established, and is nowhere better exemplified than by looking at the map of Mexico, where, from Tuxtla, on the Gulf of Mexico, to the Revillagegido Islands, on the Pacific shore, is nearly a straight line, under the same parallel of longitude, of active craters. From Mount St. Elias, on the Pacific side of the Rocky Mountains or North American Andes, to Cape Horn, or almost the whole semi-circumference of the globe, is another but more tortuous chain of burning mountains, the number of which is not even yet known.

"These are the valves by which the destructive gases are liberated, and to which the New World owes its safety, and in the original effort to reach them on the north, have the rocks been rent, and the trappose formations of the Canadas been called into existence.

"In Lower Canada, it is probable, as we have already stated, there has been an offset to these breathing holes of the Fire King, for there, in the country lying along the southern shore of the Gulf, and in some parts of its northern littoral, near the Saguenay, there are those dome-shaped mountains which were, no doubt, originally active, and which, when explored, will exhibit traces of their former use. Nothing can be more wild, dreary, or magnificent, than the scenery of this region. Lofty cones (such as those named the *Paps of Matane*), in the interior, show themselves to the observer from the deck, as he coasts along from Anticosti up the Great River, whilst the shore is bounded by tremendous mural precipices, hundreds of feet in perpendicular altitude, and the country appears broken and disrupted into every imaginable form that the most awful idea of earthquake could suggest.

"The highest mountain known in this portion of Canada, has been ascertained to be three thousand seven hundred feet above the sea; but as the country has never been much explored, it is not improbable there are others yet higher."

A Practical Treatise on Railroads and Locomotive Engines, for the use of Engineers, Mechanics, and others. By LUKE HEBERT, Civil Engineer and Patent Agent, &c. Kelly, London. 1837.

The present treatise embraces a general review of the progress of railways and locomotion, in chronological order, minutely describing the numerous inventions which have been brought forward by the various persons who have directed their attention to these important objects. The Editor observes, in his preface, that "the treatise now offered to the public, forms the article 'Railway,' in the 'Engineer's and Mechanic's Encyclopædia;' but in consequence of the very numerous applications made for this portion of the work, it has been deemed expedient to publish it in a separate form." From the great interest which railways possess at the present time (an interest which is rather likely to be increased than diminished, as in process of time these important works shall be gradually completed, and develope their full power over the aspect of society), we think the Editor has acted wisely in detaching this article from the work in which it first appeared, and publishing it in its present cheap, useful, and accessible form.

A considerable portion of the work is, of course, compilation, but much appears also to have been derived from original sources; and from the variety of information brought together, and the very numerous illustrations by which it is accompanied, we have no doubt the work will be found of much general utility, more especially by those who are professionally engaged in engineering and mechanical pursuits.

The work is of too technical a nature to afford much room for extract, we shall, however, quote the author's opinions on a subject, which, although now dormant, has engaged much attention, on locomotion by steam on common roads:—

"But the well-directed skill and admirable perseverance of Mr. M'Adam having, about this period, brought our public roads into a high state of improvement, had the effect of removing, at the same time, the only insuperable obstacle to the application of locomotive steam-carriages thereon: accordingly, we find numerous projectors and speculators successively appearing for the honour or the profit of their successful introduction. To attain that object, however, there are two things essentially requisite—capital and skill; and these must be employed in combination, and to an extent which has not hitherto been practised; otherwise disappointment will continue to be the bitter fruit of experience in this interesting and important branch of mechanical science. In some instances gold has been wanting where skill was abundant; and, in others, gold has been abundant where skill was wanting. From these causes, separate or combined, in an undue ratio, steam locomotion upon the common road has made but little progression since the time of Trevithick, notwithstanding the vast aid derived from M'Adam, and, more recently, from the labours of Telford and M'Neill."

We extract the following condensed information on railway statistics—a subject of vast importance to the railway speculator, as regards the ultimate success of his projects, and the probable returns from the capital he has invested:—

"*Statistics of Railways.*—The Liverpool and Manchester railway, was mainly designed for the transport of goods at the rate of about ten miles per hour, but it was found that treble the required speed was easily attainable by the improvements that were made in the *engines*; it became, in consequence, a more important object to carry passengers, and the result has been a continually increasing amount in their number. The ingenious Dr. Lardner has been at some pains to discover a statistical law, by which the increase of intercommunication is governed. The doctor has made some very interesting statements on this subject, which we shall endeavour to compress into a small compass. Previous to the establishment of the Manchester and Liverpool Railway, the number of passengers making one trip was 400 per day; immediately afterwards it rose to 1200 daily. Since that period the number has regularly increased, and it now amounts to 1500, which is a further increase of one in four. Previous to the railway there were twenty-six stage coaches daily running between Manchester and Liverpool; now there is but one. The time of the journey by the fastest coaches on the road was three hours; by the rail, it is one hour and twenty minutes. The rate of the fares is similarly reduced. This diminution of both the time and expense of travelling has increased the passengers fourfold. Between Newcastle and the village of Hexham, the effect of the railway there has been to increase the number of passengers from 1700 to 7060; which is also a fourfold increase. Between Dublin and Kingstown the increase has been from 800 daily, to an average of 3300; also a fourfold increase. Having given these examples to prove the *ratio of increase*, the learned Doctor shows that this increase was owing more to the *saving of time* than of money, by reference to the Dublin and Kingstown Railway, where the price was actually raised higher than by the ordinary vehicles."

We may conclude our notice, by expressing our best wishes for the success of the work, and that it may obtain the large circulation for which it appears peculiarly adapted.

Views on the Newcastle and Carlisle Railway—from original drawings by W. J. CARMICHAEL; with details by J. BLACKMORE, Engineer to the Company. No. I. Currie and Bowman, Newcastle; Thurnham, Carlisle; C. Tilt, London. 1836.

This is one of those illustrative works which have grown out of the great railway enterprises of the present day; and when we state that four exquisitely-engraved views of picturesque scenery on the line of the railway, together with a short and appropriate letter-press description, are offered to the public at the price of three shillings, we have fairly announced its claims to public favour, which, although more immediately to be anticipated from those locally or otherwise interested in the undertaking, may also be expected to embrace a still wider range of the admirers of the fine arts.

The work is dedicated to the Chairman and Directors of the Newcastle-upon-Tyne and Carlisle Railway Company, and we are pleased to find it stated in the prefatory address, "that the satisfactory results obtained since the opening of those parts of the railway already made, exceed the expectation of the most sanguine, and render certain its ultimate success."

We need hardly observe, that this railway, with its dependencies, will possess the peculiar feature of first throwing open a locomotive communication between the eastern and western coasts of England.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. VI.

OBSERVATIONS ON ARTESIAN WELLS.

In our Foreign Extracts we have before adverted to the subject of Artesian wells, and we here subjoin a very familiar explanation of the theories which have been proposed to account for their existence, and the general principles on which they appear to be dependent:—

The existence of subterranean currents of water has been known from time immemorial, and these frequently rise to a much higher level than their original apparent source, in certain mineral masses, when they are reached by a well or bore-hole. This ascending power is sometimes so great as to raise the water to the surface of the earth; and it is even capable of being raised to a much greater height by means of pipes. It was in the province of Artois that this principle was first applied on a large scale, and it is found that water thus procured is usually of superior purity to that obtained from common wells, since the former mostly passes through strata of very simple composition; although, when it has come in contact with *pyritous* soils, it contracts a hydrosulphuric odour and a ferruginous taste, which then proves an objection to its use. In boring, however, it is, in fact, scarcely necessary to notice, that the water filtrated from other parts is excluded by means of pipes or tubes used for the purpose.

The origin of Artesian waters has long been a subject of discussion; and there are only two hypotheses which will bear a rigid examination, and it is not improbable that both of them are correct, although ascribing to different causes the ascending power of the water. In most cases an Artesian well may be nothing else than the vertical branch of a syphon; the other branch being very little inclined, and, consequently, having its outlet at a considerable distance. The water rises in the artificial branch in proportion to the elevation of the natural one; if this natural branch be higher than the surface where the boring is performed, the water will rise above this level, otherwise it will not reach it. And here we must not omit to take into account the friction of the sides of the tubes, which will be proportional to the height of the syphon; and, it may be remarked, that the ascending force diminishes according as the diameter or bore of the tube is increased, so that a column of water may ascend several yards in a tube of a few inches diameter, whilst in a well, several feet broad, it would not reach the top. The second theory is, that the pressure of one stratum upon another, in like manner, acts upon the waters contained in the lower strata, which thus acquire an ascending power, whenever by means of boring a free exit is allowed for it to the surface. The first of these hypotheses seems the most to coincide with the known laws of fluids. The constant supply of Artesian wells necessarily denotes a permanency in their source, and this can only be ascribed to the filtration either of rain water, or of streams or lakes, &c. We, therefore, incline to the theory of the syphon, rejecting numerous others, and that of capillary attraction among the rest.

Whenever it is found desirable to bore for water, a knowledge of geology will be found an admirable ally, by pointing out the probability or even the certainty of success in certain localities, or, on the other hand, by deciding upon the inutility of an attempt. The following principles, accordingly, seem to be established, viz., that water will be found to exist in a pervious stratum, situated between two other impervious ones: for instance, sand is known to be pervious, whilst, on the contrary, argillaceous soils are not so; consequently, alternate strata of sand and clay will be the most favourable for boring.

Crystalline strata form the other extreme, and, therefore, boring commenced in porphyry or granite would not have the slightest chance of success, unless by a very remote probability a fissure be met with containing water derived from a higher level, and, consequently, possessing an ascensional power. It is in strata such as above described, that natural Artesian wells are formed; the water in the lower strata rising through the fissures, and giving rise to springs, which often throw back the sand and stones thrown into them. Many marshes and lakes are the feeders of these springs, so that in a dry season, when their level, by evaporation, becomes more depressed, the points of communication with the springs may be observed by a bubbling, which more or less agitates the surface.—*Traité de Geognosie*, vol. iii., p. 622.

ON THE EXTRACTION OF COPPER FROM COPPER PYRITES IN REVERBERATORY FURNACES.

The following extract from a valuable German work, describes a novel method of treating copper pyrites, and may prove interesting to such of our readers as are engaged in metallurgical operations:—

The strong tendency of oxidalated iron to unite in the form of scoria with silica, and to form a very fusible silicate of iron, induced M. Bouesnel to attempt the production of copper from copper pyrites, by an extremely simple process. Finding that the scoria produced, by smelting old bar iron over the sand moulds, in a reverberatory furnace, contained sixty-eight per cent. of oxidulated iron, and presented a very fusible combination, he conceived that the sulphureous combination of copper and iron, in iron pyrites, as well as in copper ore, might be easily separated, and the copper be extracted in a pure state, if the ore were completely freed from sulphur by roasting, and then smelted with pure quartzose sand; the quantity of which must be proportional to the oxide of iron in the ore. The ore which he used for trial contained—

Silica	3.5
Copper	23.9
Iron	25.5
Sulphur	29.0
Oxide of iron	9.2
Ditto of copper	6.4
Loss in water and carbonic acid	2.5
	100

After complete roasting, the ore ought to contain forty-six parts of oxide of iron, in consequence of the oxidation of the reguline metals in the mixture; and as sixty-eight parts of oxidulated iron correspond to seventy-five of oxide of iron, consequently the forty-six parts of the oxide are equal to 41.7 of the protoxide, and the latter require, in the proportion of sixty-eight of the protoxide to thirty-two of silica, about twenty parts of silica for vitrifraction, or forming a scoria. But as the o

already contained 3.5 per cent. of silica, he only added eighteen parts of white quartzose sand to the roasted ore; poured a little oil on the mixture, partly in order to reduce the copper, and partly to promote the conversion of the oxide of iron into a protoxide, since the oxidated iron becomes vitrified, or converted into a scoria, with the silica in a state of protoxide. He then placed this mixture in a clay retort, not lined with coal-ashes. On being smelted in a forge, the material gave a very beautiful red copper grain, weighing twenty-nine parts. The scoriæ had exactly the appearance of those produced in the reverberatory furnace on working old iron slags. In order to reduce, on a large scale, the silicate of copper (and copper ore), only two operations are necessary, namely, roasting, to remove the sulphur, and smelting the roasted ore with pure quartzose sand. The roasting should be effected in a reverberatory furnace, and in like manner the smelting of the roasted ore, mixed with the proper quantity of quartzose sand and coal-ashes, should take place in similar furnaces, in which there is a deep basin or pit for the reception of the reguline copper. M. Bouesnel considers this method preferable to the usual process of raw smelting or re-smelting, and the repeated roastings which they render necessary.—*Karsten's Archiv*, vol. vii., p. 214.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

SOCIETY OF ARTS.

ECONOMY IN MINING.—A lecture on this subject, descriptive of the recent improvements which have been made in the processes connected with the return of ores, and the mode of operations practiced in their extraction, was delivered in the rooms of the society on Tuesday evening, by John Taylor, Esq., F.R.S., to a full auditory, and afforded much gratification, as well as instruction, to those assembled. It will be in the recollection of our readers, that a report of the annual address (for such we should wish to consider it) which was delivered last year, appeared in our columns, and at great length in the pages of the *Mining Review*. From the circumstance of the lecture being illustrated by several models and diagrams on that occasion, it was impossible to do either justice to the lecturer or to the subject. We are, however, enabled in the present instance to furnish the substance of the observations made by Mr. Taylor, and from the interesting matter on which they treat, we cannot doubt but that they will be considered, not only as highly creditable to that gentleman's acknowledged acquirements and practical experience, but will be read with pleasure by those embarked as capitalists in working of mines, or who may be more intimately associated in their practical working.

The present is one of the few opportunities afforded of collecting information from lectures on the subject of mining; and it is with feelings of pleasure we gather therefrom, that Mr. Taylor still feels the importance to be attached to the establishment of a School of Mines, to which we shall continue to direct our attention, and shall rely with confidence on his able support in bringing to perfection a project, in which, we believe, for many years, that gentleman has taken considerable interest.

On a former occasion I gave some account of improvements in the mechanical applications to mining, and gave some details as to the beneficial influence produced by these advances in physical science, upon a great and important branch of national industry.

I then pointed out, that as the metals were originally found near the surface of the earth, they were obtained in limited quantities by operations conducted in a rude manner, and requiring but little skill to accomplish their object.

That when the principal depositaries of the ores were ascertained to be veins passing nearly perpendicularly into the rocks which form the crust of the globe, that their pursuit in depth would be impeded by water, and other obstacles requiring the assistance of a more advanced state of the arts would be demanded.

I showed how adits were driven from the vallies into the hills, forming drains to let off the water; how machines were constructed for drawing up water in other cases by the application of horse power, or for pumping it out by the use of various contrivances, by which falls of water were made to operate; and lastly, as connected with the drainage of mines, I took a historical review of the adaptation of the grand invention of modern times to this purpose, and traced the improvement in the powers of the steam-engine from the period of its first application to mining purposes, and this application was one of the earliest which was made of its extraordinary and comprehensive usefulness.

I showed that as at first it required a bushel of coal to raise about five million pounds of water to the height of one foot, so by progressive improvements, matured in a long period of time, and by the ingenuity and attention of many persons, the same quantity of coal has been made to raise ninety million pounds the same height, or to produce an economy of fuel equivalent to a saving of expense from sixteen to one.

In the use of the steam-engine for mining purposes, I noticed also a very important feature in this admirable invention, and which, indeed, is common to all the purposes to which it has been adapted, and which is, that its services may be called into action whenever they may be wanted, and that they are not limited by situations, or many circumstances which often preclude the application of other means. Thus, for adits, we may require variations in the levels of the ground, and for water power, we require not only such variations to produce adequate fall, but we must have also streams copious enough to propel machinery, and sufficiently regular in their supply to prevent that intermittent effect which often destroys so much of their usefulness.

The steam-engine, on the other hand, cannot only be applied to the greatest variety of purposes, but it may be placed in any situation to which fuel can be conveyed to it, and being thus adapted to every possible case, has been the means, of which some remarkable instances were adduced, of opening to the industry of man deposits of mineral wealth heretofore inaccessible.

From the consideration of the first movers, I directed your attention to improvements made in the apparatus used for raising the water from great depths in mines, and showed, by models and drawings, how pumpwork was now more accurately constructed, and better adapted to the purpose than in former times.

I noticed the progress made in subterranean surveying, and the great accuracy resulting from it in many difficult operations, and particularly in executing very deep shafts, where the working had been carried on from many points, and made to intersect with extraordinary precision.

Improvements in the use of gunpowder, which is one of the most important auxiliaries to the operations of the miner, and in the means for producing that degree of ventilation which is so necessary to allow the pursuit of his labours, were pointed out, and reference was made, in speaking on the latter subject, to the curious, and now generally admitted fact, that the increase of temperature which is found to prevail as we penetrate to greater depths from the earth's surface.

From the mechanism employed to enable us to follow the ores, and to extract them from great depths, in which I noticed the facility afforded by another application of the steam-engine to the drawing ores to the surface, I proceeded to that which is used in separating them from the earthy matrix in which they are imbedded, and in which they are commonly intimately combined; and I showed, that though improvement in this department was not so striking or decided as in others, and though there did not, indeed, exist the same capability of making, yet that considerable progress had been made, and that ingenuity had been extended to this as well as to the other means of keeping up and increasing the supply of the metals, for which the progress of the arts of life and of civilization is ever creating a greater demand.

I noticed, in conclusion, some ingenious devices for diminishing the labour and increasing the security of men in descending to, and ascending from, great depths, and which promise to accomplish that object, though circumstances have hitherto delayed the trial of their utility.

Being requested to continue this subject, I have been unwilling to refuse to contribute, in however slight a degree, to your information or amusement, though I fear that I may fail to make what remains to be said very interesting, and particularly as it is not capable of the same kind of illustration as the matter that has preceded it. I shall attempt to pursue the investigation of the progress that improvement in the art of mining has made in this country, referring to such cases as may occur to me, and which may serve to illustrate the subject.

With this in view, I may direct your attention to the the progress of improvement in the economy of mines, using that word in its largest sense, and meaning it to express that kind of good management by which not only the mechanical devices we have noticed are directed to their varied purposes with the best effect, but by which also the great quantity of human labour which is necessarily employed is regulated, and the best exertions of the labourer are stimulated and brought into profitable action.

Important as the improvements are, which we have contemplated in the instruments which the progress of physical science has placed in our hands, those which relate to the government of large bodies of workmen, to the inducement to active enterprise on the part of the labouring miners, to the removal of difficulties in their way, or of placing them in circumstances most favourable to effective exertion, are even more important, and to this may be added the judicious application of those very inventions which have been noticed.

It must be recollected that, after all, the great expenditure in mining is for manual labour, and that we have no means as yet devised for penetrating the rocks which contain mineral treasures but those afforded by the patient and unremitting labour of a great number of men. The regulation, therefore, of this force, and its due application is, after all, more important to the success of mines than even the most ingenious mechanical expedients.

As an army would undoubtedly fail, however well provided with the most perfect artillery, and all the best constructed implements of war, unless the men of which it might be composed were well directed, their efforts well combined, and their courage assured by reasonable prospects of success, so in mining we may collect and apply the most complete mechanical arrangements, but if the greater power of manual labour be not wisely directed, no beneficial results can be expected.

Improvements in this vital part of the economy of mining, are therefore deserving of the most earnest attention on the part of those who would understand the subject, and particularly as I am inclined to believe that they have made a great progress in this country, as well as those which relate to mere physical resources, and that we excel in this respect nearly as much as we do in the other.

The subject is the more interesting now, as it relates to the education of those to whom the charge of managing mines is intrusted; and as the manifest deficiency in this country of a school where the art of mining might be taught, and, with proper arrangements, many branches of civil engineering also, has of late attracted the attention of enlightened and influential persons, by whose aid, it may be hoped, an object so desirable may at some time be attained; it is not unseasonable to consider what the matters are that it is most important should be taught.

There is a striking difference in the economy of mines observable in this country, and in the principal mineral districts of Germany, which I quote as exhibiting a well-organized system, and having deservedly a great reputation.

The difference has arisen from the circumstance that in Great Britain mining is the affair of individuals, while on the Continent generally it is conducted by the Government. In the one case, therefore, the interest of the parties has turned the course of management into a direction, calculated to produce the greatest profit in the least time; and in the other, the object of the Government management seems to have been rather to produce a regulated supply of the metals, and a source of employment to their people, as little subject to fluctuation as possible.

It would be in the province of the political economist to discuss which may be most for the interest of the commonwealth; and I shall not attempt any argument on this part of the subject, though I may express my own belief that our own system has strong claims to a preference.

The continental management of mines is arranged, therefore, upon a basis resembling that by which an army is organized. The officers are brought up and instructed for the purpose; they have regular commissions, and each their appropriate rank, and the men are directed by them, and each performs an allotted portion of labour.

The most perfect system of this kind is to be found in Saxony, and the seat of the principal mining administration is at Freyberg, where a very celebrated mining college affords the means of study in every department connected with the subject, not only to the natives of Saxony, but to all foreigners who may wish to avail themselves of its advantages.

The supreme direction is intrusted to an individual who has the title of *Oberberghemptmun*, and who is generally a nobleman of distinction.

He is assisted by a council called the *Berghampt*, to which all subjects of management are referred. It consists of a certain number of the principal officers, who have besides, their separate duties in the administration.

The mining corps is divided into three bodies; the first being the miners, the second the smelters, and the third the foresters, who attend to the supply of timber and fuel to the mines and reduction works. They wear different uniforms, and there is a very minute subdivision of duties.

Thus, in the mining department, there are officers superintending the underground works, with various degrees of rank, others who manage the machinery, and others again who direct the working the ores, and preparing them for the smelting-houses.

Upon every operation which may seem to require deliberation, these officers have to report to the Berghampt, or council, and are generally expected to prepare long-written descriptions of the matter to be discussed, and which are called Acts.

The labouring miners are marshalled into detachments, who relieve each other at regular times, and each man is expected to perform a certain portion of labour allotted by the underground officers under the controul of the council.

This system appears very beautiful in its arrangements, and it ranks with an order and regularity that is very captivating, and it has accordingly been highly extolled.

It has, however, great faults, and such as would render it totally unfit for imitation here. In the first place, the number of officers is so great as to entail a very heavy expense in relation to the value of the produce of the mines, next the deliberations of the Berghampt are often protracted to a very inconvenient length, and by so much discussion fit opportunities for action are lost, and all the inconveniences of divided opinion are incurred, and this to an extent, that in the opinion of many well informed persons, is often very prejudicial. Again, the responsibility is so divided, that it almost ceases to be an active principle, and to produce the effects that when properly placed ought to be expected from it.

The effect upon the men of allotting a certain task to each, is evidently to limit the exertions of the whole, if not to the minimum of power of each individual, at least to something like the average.

But the great defect seems to be, that it wants the vivifying principle of self-interest, by which, as it will appear, when we come to consider the system of management adopted here, we shall find that the greatest effect in stimulating the labour of the workmen is produced.

In Great Britain the mines are worked at the risk of private individuals, who are generally associated in companies, consisting, as relates to the most important undertakings in the country, of but a small number of individuals, holding shares in various proportions. They hold the mines by leases granted by the landholder for certain terms; and the mode of working is regulated by covenants suited to the circumstances. The dues, or rent paid, is usually a portion of the produce, or of its value in money. The company, who are the lessees, and who work the mine, are called the adventurers, and the owners of the soil the lords.

The whole management is vested in the adventurers. The terms are those used in the mining language of Cornwall; and as in that district we may find the most completely organized system, it is from thence that I take my description.

As each set of adventurers are at liberty to adopt such mode of management as to them may appear most fit, so there is rather a general coincidence rather that an absolute uniformity of practice.

The most important class of officers, to whom the practical direction is intrusted, are called captains, and are generally selected from the most intelligent workmen. Their duties in large concerns are divided, and a difference in rank is kept up, but the principle of responsibility is never lost sight of, and they are stimulated by the prospect of advancement which is often afforded to them.

It is not saying too much of the captains of mines, to assert, that, as a body they exhibit very remarkably the good qualities which are to be most desired for their important duties; while among them several are to be found who combine higher qualifications than the limited education they can usually obtain would lead us to expect; and there are some who have merited and obtained, not only from their employers, but from all classes of their neighbours, high degrees of confidence and respect.

One captain of the greatest experience usually governs the others, and in conjunction, and under the advice of one of the partners, or some person appointed as the principal manager, attends to all the business of the concern, while the departments of account, of the construction and care of engines, of the purchase of the various articles used, of the ore dressing, &c., are superintended by persons appointed by the manager and principal captain. Upon them, indeed, is thrown generally the great weight of responsibility, and, therefore, the appointment of their subordinate agents. And it will at once be seen, that it is their interest, as it is their duty, to avail themselves in the choice of assistance, of merit where they can find it, and that, from the number of persons under their eye, it is often not difficult to select those who are best adapted to fulfil the duties required.

[To be continued.]

GEOLOGICAL SOCIETY.—WEDNESDAY, FEB. 22.

The Rev. W. WHEWELL, President, in the Chair.

A paper was read by Captain Grant, of the Bombay Engineers, on the geology of Cutch.

This district, so peculiarly interesting on account of the earthquake by which it was devastated in 1819, is bounded on the west by the eastern branch of the Indus and the territory of Sinde, on the north by the Thur or Little Desert, on the east by the province of Guzerat, and on the south by the Gulph of Cutch and the Indian Ocean.

It is naturally divided into two districts, distinguished by their physical features. The northern, called the Great Runn, is a sandy flat containing about 9000 square miles; but the southern is a hilly district, consisting of about 6500 square miles. The formations of which the latter is composed are arranged by the author under seven heads. 1. A system of laminated shale, limestone, and sandstone, abounding with ammonites, belemnites, and other fossils characteristics of the secondary formations of Europe. It occurs principally in the northern part of the district, constituting a range of hills which borders the great Runn.

2. A series of sandstones and shales, inclosing layers of iron ore and thin beds of coal, sometimes tolerably good, but generally very impure. It forms the central and principal part of the district, rising also into a chain of hills. Captain Grant was not able to determine satisfactorily its age with reference to the preceding deposit. The iron ore is smelted by the natives to some extent, particularly near the town of Doodye. The variety generally selected, on account of the imperfect apparatus employed, has a spongiform texture, small specific gravity, and is easily frangible. The ore is broken into small pieces, and disposed in layers alternately with others of charcoal, in a rude, open furnace, acted upon by two small bellows made of sheep-skin. The metal on being fused falls into a small hole at the bottom of the furnace, whence it is removed into an inclosed furnace, and subjected to similar blasts, till it acquires a white heat, when it is taken out and beat into a bar.

The third formation is a white limestone, which occupies a small area south of Luckput, on the Indus, and contains innumerable nummulites, and fascioolites, also echini, spatangi, and corals.

4. A series of strata considered by the author as tertiary, on account of its fossils. The principal genera mentioned in the paper are, clypeaster, pecten, ostrea, cardium, conus, cypræ, solarium, ovula, fusus, and strombus, the species being often grouped in beds; and in some localities there are patches of corals, two or three acres in extent. The tract occupied by these strata ranges along the southern side of the province.

5. Another sandstone deposit was noticed by Captain Grant, though without being able to determine its geological position with reference to the other formations. It differs very materially from that connected with the coal, being much softer, and of a greater variety of colours. Associated with it are beds of variegated clay, and it is overlaid by an aluminous earth, which is covered by a bed of red clay.

6. ALLUVIAL DEPOSITS.—Under this head Captain Grant described the changes produced along the southern coast by the accumulation of sediment. At Mandaree, three miles inland, is a ruin called the Old Bunder, or quay; and in the centre of the town is a small temple built upon a rocky foundation, but said to have stood in the sea when the Old Bunder was the landing-place. At other localities in the Gulph of Cutch similar processes are going on, rendering it necessary to remove the landing-places frequently further seaward. The same operations are also in progress over a district, not situated immediately on the coast, but connected with the gulph by small creeks, some of which penetrate six or seven miles into the interior. This district is covered with shrubs, which at low water are exposed to the roots, but at high tides have merely their tops visible, so that boats appear to sail through a marine forest. The growth of the shrubs is rapid, and the sailors have constantly to force their vessels through the upper branches, particularly at the bends in the creeks, when they wish to save a tack. The stems and lower boughs are covered with testacea, while the upper are occupied by numerous water fowl. During the monsoons the water of the creeks is charged with mud, and passing but slowly through the shrubs, a great portion of the sediment is precipitated. In August, 1834, the rains were very violent and continuous, and the river Nurra covered with a fine soil a surface of nearly 1000 acres.

7. VOLCANIC ROCKS.—In the southern part of the province is a range of hills composed entirely of basalt, with other volcanic rocks; and extensive similar formations occur a little to the south of Luckput; and minor outbursts are scattered over the central districts. These rocks were described by Captain Grant with considerable minuteness, and he enumerated a great variety of instances in which the disturbances of the strata can be traced in the clearest manner to the protrusion of trap. He shewed also that eruptions had taken place at many distinct periods, beds of basalt, trachyte or amygdaloid alternating with each other and with limestone, calcareous grit, and tuff. Among the phenomena connected apparently with volcanic action, is a number of convex mounds, varying in diameter from three to twenty yards, and covered with small tabular plates of sandstone, the lines of fracture radiating, though irregularly, from a centre. In some instances the summits had been removed and a circle of stones was displayed, inclosing an area of sandstone, the fractures in the stones decidedly radiating as the stones of an arch. In other instances the mounds assumed the magnitude of small hillocks, from which the outer coating having generally fallen away, the whole presented a heap of broken masses of rock. Another class of volcanic phenomena occurs near the village Wagé-ké-Pudda, where a district of about two square miles, forms a table land which is covered by mounds of loose volcanic scoriæ. The platform itself consists of marl, and the sides are fissured and flanked by low irregular hills of ironstone and gravel. From the loose nature of the scoriæ, and the facility with which it is removed by atmospheric agents, Captain Grant inferred that the mounds have been thrown up at a comparatively recent period.

The paper concluded with an account of the Great Runn. This singular region, as already described by Captain Burnes, consists principally of a sandy flat, for the greater part of the year dry, but during the prevalence of the S. W. winds converted into an inland sea, passable, however, on camels. Captain Grant believes that the present oscillating position between land and water of the Runn is due to its elevation, and not to a depression in the level of the sea; and in support of this opinion adduced, the alterations both of elevation and depression produced by the earthquake of 1819. The author described also several extraordinary walls of rock, thrown up, apparently, by volcanic action, some of them assuming a dome shape, others segments of circles, or straight lines.

WEDNESDAY, MARCH 8.

The Rev. W. WHEWELL, President, in the Chair.

The reading of the Rev. W. B. Clarke's paper on Suffolk, commenced on a previous evening, was concluded.

The formations of which that county consists are chalk, the plastic and London clays, crag, diluvium, or ancient superficial detritus, and recent lacustrine accumulations. Each of these deposits was described in considerable detail, as well as the changes now in operation in the river courses and along the sea coast. The following conclusions were then given as deducible from the statements in the body of the memoir:—

1. The substratum of the whole of Suffolk, Norfolk, and Essex, is chalk, which appears to have been dislocated, and worn into deep hollows by the action of water, previously to the commencement of the tertiary era.

2. On this abraded surface the plastic clays and sands were formed, but not over the whole area.

3. Partly on these beds and partly on the chalk, the London clay was then deposited, but to no very great thickness.

4. Upon the London clay, as well as the chalk, the crag was next accumulated in sand banks, produced by the tidal waters, and around projecting masses of chalk.

5. While the crags still lay beneath the sea, a violent catastrophe broke up many of the secondary strata, from the chalk to the lias inclusive, and the debris thus caused, together with numerous masses of ancient rocks, was, spread by a rush of water over the surface of the tertiary formations and the chalk, in some places to a depth of 400 feet, constituting the beds of drift clay, &c., which occupy so great an area in Suffolk.

6. Previously to this diluvial action, and after it, the inland waters of the the then dry land, bore to the sea animal and vegetable remains, vestiges of which occur in the Norfolk coast, and elsewhere.

7. That the climate of this part of the globe was then different from the present.

8. After this period, and probably in prolongation of the first great catastrophe, a series of shocks, acting from below, shattered the surface, and gradually elevated the whole district, till the crag obtained the height of nearly 100 feet above the level of the sea, and by this movement were produced the vallies, or lines of fissures, through which the drainage of the county is effected.

9. No great convulsions have since taken place.

10. By the action of springs, and the constant battering of the sea, the superficial contents of the London clay and crag have been reduced several miles, vestiges of their former extent being traceable in rocks and sands nearly always submerged.

11. By the set of the tides, vast accumulations of shingle and sand have been formed at projecting points, protecting, in some places, the cliffs from further destruction; but at Harwich, they have blocked up the ancient estuary, and compelled the Stour and the Orwell to form a new outlet.

12. The average amount of annual degradation of the coast is about two yards in breadth; and, in consequence of the conformation of the ridges of crag and London clay, the cliffs will gradually diminish into a low sandy shore. The period estimated for effecting this destruction is calculated by Mr. Clarke to be another century.

The next paper read, was by the Rev. David Williams, F.G.S., on the raised beaches of Saunton Down and Baggy Point. These beaches were recently described by Professor Sedgwick and Mr. Murchison, and Mr. Williams, in this paper, fully agrees with the conclusions drawn by those authors relative to the beaches having been raised.—(See *Mining Journal*, Supplement IX., p. 36.)

In addition, however, to the proofs afforded by the numerous remains of

existing British marine shells in these accumulations, he stated that he had found in many places from six to ten feet above the tidal level, and at the line of contact of the beaches with the old rocks of the district, countless balani attached to the surface of the latter, but entangled in the substance of the former. In support also of the land having been raised, and not the sea depressed, he referred to the submarine forests in the prolongation of the same coast, and argued that their position could not be accounted for by a subsidence in the sea level, but by an unequal movement of the land.

The third communication read, was from Mr. James de Carle Sowerby, on a new genus of fossil shells, named by him tropæum. The following are the characters given in the paper:—"An involute chambered shell, with sinuated septa; the whorls free sometimes, very distant; siphon in the external margin." The shells which may be grouped in this genus have hitherto ranked as hamites, but have no sudden bend which may be compared to a hook. The place of tropæum is between hamites and scaphites. The species hitherto found have been obtained from the gault and greensand.

ADDRESS TO THE GEOLOGICAL SOCIETY,

DELIVERED AT THE ANNIVERSARY, BY CHARLES LYELL, JUN., ESQ., PRESIDENT.

Gentlemen,—You will have learnt from the Treasurer's Report that the finances of the Society are flourishing, and they would have appeared in a still more prosperous condition, had we not expended above 500*l.* within the year on our transactions. Part of this sum has already been repaid by the sale of the volume just published, of which I may safely say that it yields to no preceding number in the value of its contents or the extent and beauty of its illustrations.

The total number of Fellows of the Society, exclusive of Honorary and Foreign Members, at the close of the year 1835, was 670; at the close of 1836, 709; being an actual increase, after deducting fourteen deaths, removals, and resignations, of thirty-nine Fellows.*

We have to lament the loss of Dr. Henry, of Manchester, so highly distinguished as a chemist and philosopher, and who took a warm interest in the progress of our science. Our list of Foreign Members has been diminished by two deaths, those of Professor Hoffmann of Berlin, and Baron Férussac of Paris.

Professor Frederick Hoffmann was suddenly cut off in his 39th year, at the moment when the scientific world were impatiently expecting his account of the geology of Sicily. You are probably best acquainted with him as the author of the great geological map of Western Germany, in which he made known the results of many years of patient and accurate research. This map, published in 1829, was divided into twenty-four sheets, and was followed in 1830 by an Atlas containing sections, and a more general map on a smaller scale of the same country. In the same year the author's Geography and Geology of North-Western Germany appeared,† which may be regarded as a commentary on the great map, comprising a description of the physical outline of the country, its mountains, valleys, plains, and river-courses, and a sketch of a portion of its geological structure, embracing the transition and secondary rocks of the Hartz, Thuringerwald, and Lower Rhine. In the larger map, all the tertiary and alluvial deposits are represented by one colour, the author having never entered upon the subdivision and classification of these formations. He had studied, however, the newer secondary formations, which were depicted by several distinct colours, and their history would have been included in the work above alluded to, had he not been interrupted by his tour in Italy and Sicily in 1830.

Among his other writings, I may enumerate an Account of Magdeburg, Halberstadt, and the adjoining territory, and various papers which will be found scattered through the journals of Poggendorff and Karsten, the Hertha, and other German periodicals. The only fruits which we as yet possess of the scientific expedition sent by the Prussian Government, under Hoffmann's direction to Italy and Sicily, are some letters written by him during the journey, and an excellent Memoir on the Lipari Islands; and a valuable work by one of his companions, Dr. Philippi of Berlin, who published in Latin a detailed account of the recent testacea of Sicily, and the tertiary fossil shells collected in the course of the expedition.‡

From Hoffmann's letters it clearly appears that the novelty of the volcanic and tertiary phenomena of Southern Italy and Sicily had made a deep impression on his mind. He had been astonished on recognising the identity of the modern trap rocks of the Val di Noto with those of ancient date in Germany, and the no less striking similarity of the Sicilian tertiary limestones, containing recent shells, to many calcareous secondary formations of northern Europe. The Lipari Islands afforded him a field for the examination of modern igneous rocks, and the slow effects of volcanic heat in modifying aqueous deposits. The picture which he has given of the fumeroles of the western coast of Lipari, the principal island of the group, is graphic and highly instructive. At St. Calogero, numerous fissures are seen permeated by heated vapours, which are charged with sulphur, oxide of iron, and other minerals, in a gaseous state. Here the tufaceous and other rocks are variously discoloured wherever the steam has penetrated, and are sometimes crossed with ferruginous red stripes, so as to assume a chequered and brecciated appearance. In one place a felspathic lava has been turned by the vapours into stone as white as chalk marl; in another, a dark clay has become yellow or snow-white, and these effects are not limited to a small space, but are seen extending for four miles through horizontal strata of tuff, which rise occasionally to the height of more than 200 feet. The greater part however, of the alterations are referred to what are properly called extinct fumeroles, or the action of volcanic emanations which have now ceased, but which must at one period have resembled those of St. Calogero. Some of these have produced veins of fibrous gypsum, calcedony, and opal, minerals which must have been introduced into the rents in a state of sublimation.§

In some places there are tufaceous marls, regularly alternating in thin beds, with still thinner and countless layers of granular gypsum, the whole mass being again run through everywhere by irregular branching veins of silky fibrous gypsum. These strata, thus intersected, present a perfect counterpart to some of the secondary gypseous marls, both of the keuper and variegated sandstone formations in Germany.

When reading the Professor's description of these phenomena, we share in the pleasure and surprise which he felt on comparing strata of high antiquity with others of so recent a date, and which, moreover, owe a portion of that resemblance to changes now daily in progress.

The writings of Baron Daudebard de Férussac were not devoted principally to geology, but we are indebted to him for several memoirs, and among others, for an Essay, published in 1814, on fresh-water formations, with a catalogue of the species of land and fresh-water shells which were then known to enter into their composition. Monsieur de Férussac contributed largely to the geological section of the "Bulletin Universel des Sciences Naturelles," a journal of which he was the chief editor and original projector. This Bulletin had for its object to give a monthly analysis or brief abstract, usually unmixed with criticism, of the contents of all new publications in every department of science. The work was first carried on for a year on a smaller plan, and then assumed in 1824 its enlarged and permanent form, being divided into eight sections, one of which was devoted to Geology, Palæontology, and Natural History. A monthly number appeared regularly on this and each of the other seven sections, the whole forming together a large octavo volume. In the organization and direction of this scheme, the editor was indefatigable, and he succeeded in obtaining the co-operation of a great number of the most able and eminent writers. In announcing the original aim and scope of the undertaking, he laid stress on the difficulties under which men of science labour in procuring intelligence of new works, written in a great variety of languages in different parts of the world, and frequently buried in the voluminous and costly transactions of learned societies. He therefore expressed a hope that his Bulletin would serve as "a kind of telegraph" for the rapid conveyance of the earliest intelligence of inventions and discoveries, so as to prevent philosophers from wasting their time and money in slowly feeling their way to results already found out by others, and attaining with great labour the very points from which they might have started. The Geological section of the Bulletin was ably supported by MM. Boué, Brongniart, and other writers, and survived the other sections for some time, maintaining itself for seven years, till at length it was given up in 1831 for want of sufficient encouragement.

The works of Baron Férussac on Natural History, and especially Conchology, would deserve from me a fuller notice, if they were not irrelevant to the subject of this address.

HOME GEOLOGY.

I shall now commence my retrospect of the proceedings of this Society, during the last year, by considering those papers which have been devoted to the geology of the British Isles. There is probably no space on the globe, of equal area, which has been so accurately surveyed as this kingdom; yet the most experienced geologists are now exploring several parts of it with the feeling that they are entering upon terra incognita. Not only do they find it necessary to trace out more correctly the limits of formations previously known, but also to introduce new groups of fossiliferous strata and new divisions, in districts before supposed to have been well investigated.

The carboniferous deposits which are alike interesting in a scientific and economical view, have deservedly occupied of late the particular attention of many able geologists, and we have received communications on the subject from Mr. Murchison, Mr. Prestwich, Professor Sedgwick, and Mr. Peile. The observations of Mr. Prestwich relate to the coal-measures of Coalbrook Dale, and the formations immediately above and below them, together with the accompanying trap-rocks.

There is, perhaps, no coal-field in the whole country of equal size, in which the strata have been so much dislocated and shattered. Mr. Prestwich gives a detailed description, both of the principal and minor faults, their direction, extent, inclination, breadth, and fall, and the difference of level produced by them in their opposite sides, which is sometimes slight, but sometimes amounts to 600 or 700 feet. In some instances the change of level is by steps or hitches, which, it is truly said, may be owing, either to unequal resistance, or to a series of small dislocations. The walls of the fissures in the disjointed strata are sometimes several yards apart, the interval being filled with the debris of the strata. In other places they are in contact. In this last case it is particularly remarked, that the surface of the ends of the fractured beds of coal and shale is shining and striated. You are aware that this appearance has usually been attributed, and I believe rightly, to the rubbing of the walls of the rent one against the other, the lines of the polished and striated surfaces indicating the direction of the motion, but I have lately seen it objected to this theory, that the striæ are not always parallel, but often curved and irregular, and that the earthy contents of veins and faults often present the same glittering and striated faces, or slickensides, as they have been called. I am familiar with the fact, and have always inferred, that the movements were irregular and complicated, occasionally changing their direction, and that even when uniform, they may have acted unequally on materials varying in hardness and pliability. It is much to be desired, that scientific travellers, who visit countries shaken by earthquakes, would observe with minute care all the phenomena attending the fissuring of rocks and buildings. I have been informed by an eye-witness of one of the late minor earthquakes in Chili, that the walls of his house were rent vertically, and made to vibrate for several minutes during each shock, after which they remained uninjured, and without any opening, although the line of the crack was still visible. On the floor, at the bottom of each rent, was a small heap of fine brickdust, evidently produced by trituration. In such instances it would be desirable to obtain fragments of the rent building, and to compare them with the walls of natural fissures.

In his examination of the fossils of the coal-measures, Mr. Prestwich has shown that beds containing marine remains alternate with others in which fresh-water shells and land plants occur, appearances which he attributes to the flowing of a river, subject to occasional freshes, into the sea, rather than to repeated changes in the relative level of land and sea.

[To be continued.]

* The return of the number of Fellows, and the deaths alluded to in this address, refer exclusively to the year 1836, and not to the period intervening between the last and present anniversary.

† Orograph. und Geognost. Verhältnisse vom Nordwestlichen Deutschland, two vols. Leipzig, 1830.

‡ Philippi, "Enumeratio Molluscorum Siciliæ tum viventium tum in tellure tertiara fossilium, quæ in itinere suo observavit Auctor." 280 pages 4to, and twelve lithographic plates, Berlin, 1836.

§ Liparischen Inseln, p. 41. Leipzig, 1832.

PROGRESSIVE RISE OF A PORTION OF THE BOTTOM OF THE MEDITERRANEAN.

M. Theodore Virlet lately addressed a note to the French Academy of Sciences, in which he directed the attention of geologists to the probability of the speedy appearance of a new island in the Grecian Archipelago, in consequence of the progressive rise of a sunken solid rock (composed of trachytic obsidian ?) in the gulf of the volcano of Santorin. The following are the author's observations on this subject :—" Towards the end of the last century, at the period when Olivier visited Santorin, the fishermen of the island asserted that the bottom of the sea had recently risen considerably between the island of Little Kaïméni and the port of Thera; in fact the soundings did not give a greater depth than fifteen to twenty fathoms, where formerly the bottom could not be reached. When Colonel Bory and the author visited the island in 1829, they were able not only to confirm the truth of Olivier's statement, but also to ascertain by various soundings, that the rise of the submarine land had continued, and that at the point indicated the depth was not more than four fathoms and a half. In 1830, the same observers made new soundings, which enabled them to determine the form and extent of the mass of rock, which in less than a year had been elevated half a fathom. It was found to extend 800 metres from east to west, and 500 from north to south. The submarine surface augmented gradually to the north and west, from four to twenty-nine fathoms, while to the east and south this augmentation amounted to forty-five fathoms. Beyond this limit, the soundings indicated in all directions a very great depth. I have lately been informed that Admiral Lalande, who, since 1830, has twice returned to Santorin, ascertained that the rock still continues to rise; and that, in September, 1835, the date of his last visit, the depth of water amounted to only two fathoms, so that a sunken reef now exists which it is dangerous for brigs to approach. If the rock continues to rise at the same rate, it may be calculated that in 1840, it will form a new island, without, however, those catastrophes which this phenomenon seems to presage for the gulf of Santorin, being a necessary consequence of the epoch of its appearance at the surface of the water. Since the eruptions of 1707 and 1712, which produced the new Kaïméni, volcanic phenomena have completely ceased in the gulf of Santorin, and the volcano seems at the present day quite extinct. Nevertheless, the rise of a portion of its surface seems to demonstrate continual efforts to make an eruption during fifty years; and that, whenever the resistance shall not be strong enough to offer a sufficient obstacle, the volcano will again resume its activity."—*Edin. New Phil. Jour.*

SHOWER OF FALLING STARS IN RUSSIA, ON THE NIGHT BETWEEN THE 12TH and 13TH NOVEMBER, 1832.

The following extract of a letter from Monsieur le Comte de Suchteln, to Monsieur Feodorou, was communicated to the Royal Academy of Sciences at Paris, in which mention is made of numerous meteors which were seen in the neighbourhood of Orenburg, in the night between the 12th and 13th November, 1832.—" In the night between the 12th and 13th November, 1832, between three and four in the morning, the weather being calm and serene, and the thermometer being at fifty-five degrees of Fahrenheit, the heavens appeared to be bespangled by a great number of meteors, which described a great arch in the direction of from north-east to south-west. They burst like rockets into innumerable small stars, without producing the slightest noise, and left in the sky, what was long of disappearing, a luminous band, having all the various colours of the rainbow. The light of the moon, which was then in her last quarter, obscured this appearance. It sometimes seemed as if the heavens were cleft asunder, and in the opening there appeared long brilliant bands of a white colour. At other times flashes of lightning rapidly traversed the vault of heaven, eclipsing the light of the stars, and causing these long luminous bands of varied colours to appear. These phenomena continued to succeed each other without occasioning the slightest perceptible noise. They were in their greatest splendour between five and six o'clock in the morning, and continued without interruption till sunrise. They were observed principally by the sentinels, and by the officers when going their rounds; also by the ecclesiastics, and by the subordinates, and by many other persons. Monsieur Milordou, the principal priest of the cathedral, stated in the account which he gave of this occurrence, that the interior of the cathedral was sometimes suddenly illuminated by the light of this brilliant phenomenon. Monsieur Itschitow, lieutenant-colonel of the 3d battalion of the line of Orenburg, also confirmed these statements in his report, which, as an additional ground of confidence, contained the accounts of of the sentinels in the several positions in which they had been posted. During the same night, and almost at the same hour, a not less remarkable appearance was witnessed at Hitzkaja-Saschtschita, about seventy-five miles to the south of Orenburg. Two columns of a white colour rose from the horizon, equidistant from the moon, which, at the time, had not risen far; about the middle of their height they appeared brilliant and much curved. Several horizontal bands sprung from this point, the most brilliant of which extended towards the moon, in which they appeared to unite, so that in this way they appeared to form a great H. In the town of Ufa, the seat of the government of the same name, situated 380 miles to the north of Orenburg, a phenomenon similar to that which was observed at Hitzkaja-Saschtschita, was perceived, but, according to the accounts which have been given, it was not quite so brilliant."—*Edin. New Phil. Jour.*

Russian Characters.—It is well known, on the testimony of Arab authors, that the Russians used written characters in the beginning of the tenth century, but the nature of these characters has been hitherto unknown. AM. Frähn, of the Academy of Sciences, at St. Petersburgh, now says that they were carved on wood, and had no analogy whatever with the Sclavonic or Runic; but there is a remarkable resemblance between them and the still unexplained inscriptions on the route between Mount Sinai and Suez, attributed by common report to the early Christians, who, before the sixth century, passed that way on their pilgrimages to the Monastery of the Transfiguration.—*Athenæum.*

CARN BREA.

[Continued from No. 78.]

The discovery of Carn Brea by the Romans opened a new era in its mining history. Publius was most assiduous to cultivate an acquaintance with the surrounding inhabitants, and by his dignified demeanour and polite address soon obtained their favour. Having won their confidence, he accompanied them into the country, where he discovered the source of that article of traffic, for the discovery of which his countrymen had so long panted, and for which he had braved privation, toil, and peril. It has been supposed that he had before seen something of mining affairs on the continent, but of this there is no certainty. His penetrating eye, however, was not slow to discern the disadvantages under which the ancient Cornish laboured in procuring their tin from streams and coffans. The slow, painful, and ineffective method pursued, particularly in the latter, forced itself strongly on his observation, and he instantly set about devising more approved methods of future operation. It readily occurred to him, that from the elevated positions of several of the mines, levels might be carried in, so as not only to unwater their unseemly and inconvenient coffans, but to effect a drainage far beyond those points at which they had been obliged to suspend their operations. He conceived that by a chain of horizontal drifts and perpendicular shafts, drainage and ventilation might be effected, so as to enable the miners to extend their operations in their present workings, and even to resume their operations advantageously in those which, for obvious reasons, had been long abandoned. Having satisfied himself as to the practicability of his plans, he laid them in detail before the Cornish tinners, who had too long laboured under their painful disadvantages not to feel anxious to get rid of them. They had too vivid a recollection of the valuable courses of tin, which for want of drainage and ventilation they had been obliged to abandon, not to feel equally anxious to get them once more placed within their reach. And they had too lively a perception of measures tending to their interest, to reject a proposition broached under the idea of improving those tin returns on which their subsistence so much depended; consequently, the feasible plans of the magnanimous Roman were unanimously assented to and instantly adopted. The new system was at first attended with considerable toil and outlay, and it was long before they were enabled to procure returns; but, at length, by perseverance, every obstacle was overcome. By Cornish industry, conducted by Roman skill, adits were driven in, shafts were sunk, the lodes were intersected, and mining operations were again carried on with unprecedented spirit and success; the ancient Cornish were astonished at the superabundance of their returns, and their gratitude to their benefactor was commensurate with their obligation. Authors differ very materially as to the position of the part from which our ancestors exported their tin, and into which the intrepid Roman steered his vessel. An erudite Cornish historian has, with a great deal of plausibility, assigned the palm to Falmouth. Others have supposed that this ancient port formed a part of the Lionesse domain, and that it has sunk into the ocean with that unfortunate territory. Consequently, history does not authorise us to determine at what particular spot this improvement in the mining system first originated, but we have a variety of concurrent evidence to demonstrate, that it could be at no great distance from the celebrated Tor, which forms the subject of these papers, and to prove at least its early adoption by the tinners of Carn Brea.

(To be continued.)

Albite of Chesterfield.—This mineral has lately been analysed by MM. Aug. Laurent and Ch. Holms, who have found its composition to be identical with that of common albite, contrary to the result of Stromeyer's analysis. The following is the composition determined :—

Silica	68.4
Alumina	20.8
Iron and manganese	0.1
Lime	0.2
Soda	10.5
	100.0

from which is deduced the formula $(3Si^2O^3 + Al^2O^3) + Si^2O^3 + ONa)$ identical with that for the common variety of albite.—*Ann de Ch. et de Ph.*

Analysis of Tabasheer from India.—The following analysis is by Dr. Thomas Thomson :—

Moisture	4.87
Silica	90.50
Potash	1.10
Peroxyd of iron	0.90
Alumina	0.40
	97.77

—*Rec. of Gen.* Sc. No. XIV.

Dreelite.—Dreelite occurs in small crystals disseminated on the surface and in the cavities of a quartzose rock, which contained also a white mineral, supposed to be halloysite. The crystals were unmodified rhombohedrons of ninety-three or ninety-four degrees, of a white colour and pearly lustre; the lustre is quite brilliant on a surface of fracture. Its cleavage is indicated only by lines parallel to the faces. In hardness it is somewhat superior to carbonate of lime. Sp. gr. = 3.2—3.4. Under the blowpipe it fuses into a white blebby glass, which is coloured blue by nitrate of potash. Its analysis proves to be composed of

Sulphate of baryta	61.701
Sulphate of lime	14.274
Lime in excess	1.521
Carbonate of lime	8.050
Silica	9.712
Alumina	2.404
Water	2.308
	100.00

This mineral is named after M. de Drée, a liberal patron of science.—*M. Dufrenoy, Ann. de Chim.*

Mr. Cross's Experiments.—At the meeting of the Royal Institution, on Friday week, Professor Faraday delivered a lecture, in which he alluded to the recent discoveries of Mr. Cross, with respect to the formation or revivification of insects in flint, which, although doubted by many, he knew to be true, inasmuch as, by a continuous voltaic stream from silica of patass, he himself produced living animalculæ. He also exhibited some insects obtained from hard polished stone, and which were now, like those of Mr. Cross, enjoying life from a transition of many thousand years.—*Atlas.*

History.—The Royal Academy of Metz has proposed the following queries for the present year, as subjects for prizes. What is the real use of history? Under what points of view, and within what limits would it be advisable to teach history among the different classes of society? What is the best system for the study of elementary history, in the great schools, colleges, and primary schools? What are the best means of making the influence of the enlightened classes contribute to the happiness of the poor and ignorant? In order to obtain the above-mentioned object, what would be the advantages and disadvantages of a certain degree of patronage? Each of the prizes is to consist of a medal worth 200 francs.—*Athenæum.*

Iodine.—M. Aimé has sent a phial to the French Academy of Sciences. containing a compound liquid, which he calls Iodal, in which, according to him, the iodine plays the same part as chlorine does in chloral. It is by making iodine act upon nitric alcohol that he obtains this compound, and iodal is given in the form of a liquid much heavier than water. Its colour is at first red, from excess of iodine, but after some time it loses all tint whatever.

Fossil Remains.—AM. Fabreguette, French Consul in the island of Crete, has forwarded some fossil remains to his own country, found in the neighbourhood of the town of Canea. They are accompanied by a letter from M. Caporal, a medical gentleman, in which it is stated that these remains belonged to a young man. They most tenaciously adhered to a stone (of what kind is not mentioned), which was separated by explosion, and consist of long bones, some ribs, vertebræ and teeth, all of which are grinders. The situation was thirty feet from the sea.

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The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT—XIV.

LECTURE ON ECONOMY IN MINING.

BY JOHN TAYLOR, ESQ., F.R.S.

DELIVERED AT THE SOCIETY OF ARTS, ON TUESDAY, MARCH 7.

[*Concluded from page 51.*]

I come now to the part of the economy of mines which I think the most important, and it must be equally so in all concerns where a number of men are employed, and we may find it, therefore, more or less acted upon very generally, though, perhaps the principle is more perfectly developed in mining, than in most other things, where, indeed, circumstances seem to render this more practicable.

Mr. Babbage, in his popular work on the "Economy of Machinery and Manufactures," mentions this peculiarity in the mode of paying the miners in Cornwall. *See* Sec. 210 and 211, page 177.

It will appear that there are two kinds of contract entered into with the men, by one of which they are paid for cutting through rock generally unproductive of ore, or where the procuring it is not the principal object; and these payments are according to the measured quantity excavated. The other, which is called tribute, is an agreement by which the men working on ore ground are to be remunerated by a portion of the produce rendered on the surface in a marketable state.

On the first kind of contract I shall say little, because there is nothing essentially different from bargains similarly made in all kinds of work. But I may remark on one feature common to all the agreements made with the men in the Cornish mines, which is, that they are for short and regular periods, that is to say, for one or two months, and that the mode of letting is by the kind of auction alluded to by Mr. Babbage, and by which every bargain is open to full and fair competition. The rate of wages, therefore, regulates itself by the circumstances that ought to control it—the demand for labour. No one has heard of disagreements between the Cornish miners and their employers—no combinations or unions on the one side or the other exist; nor have turn-outs or strikes been contemplated or attempted. This plan works with perfect harmony and facility, whether as applied to tutwork or tribute; a great number of men are contracted with in a remarkably short space of time; the judgment of the agents as to the proper prices to be given is checked, and, perhaps, corrected by the knowledge of the men; all jealousy as to favouritism is avoided, and an evil consequence which might be supposed to follow, namely, heart-burnings amongst the men who compete with each other, is not at all found to follow.

Mr. Babbage says, that I have introduced the Cornish system into Flintshire, Yorkshire, and Cumberland, to which I may add, more recently into Cardiganshire and Ireland, and this has not been done without difficulty at first; and, with respect to this part of it, it has been constantly predicted, that animosities would be engendered, and all sorts of mischief would ensue. I have found the very contrary to be the case, and that the men soon found that fair play was given to all, that it left no room for undue preferences, and that by it the more skilful and industrious were as they ought to be—better rewarded, because they could offer to work at prices lower than those that suited the idle or the ignorant, and thus all classes be fairly remunerated, and these considerations had their due weight; and I know of no case where the men would wish to return to the older plan of private bargains. Though not a very recent improvement, yet it may, by its extension and modern regulation, be considered in some degree so, and very important in the economy of mines.

I have said, that by this system the rate of wages regulates itself by the demand for labour, and I have statements which show this, and how the average monthly earnings were affected by the rage for engaging in mining concerns, which prevailed in the last two years. These statements relate to the averages at the Consolidated Mines in Cornwall, and the Mold Mines in North Wales. It is also important to remark, that the rate of wages is by no means a high one, considering the kind of labour. At the Consolidated Mines, the lowest average of monthly earnings per man, working on tutwork, in one year, was 2*l.* 13*s.* 11*d.*; and the highest, 4*l.* 5*s.* 0*d.* The lowest average per man, on tribute, at the same time, was 3*l.* 7*s.* 0*d.* per month; and the highest, 4*l.* 12*s.* 0*d.* Here we see that the tributer, who must possess more knowledge and skill than the other class of labourers, also reaps a higher rate of reward, and thus again it is shown that the plan of competition works fairly.

It is the tribute system, however, which is the great improvement in the economy of mining; it has prevailed in Cornwall for some time, but it is of late years that it has been perfected. Its essential character is, that it identifies for a time the interests of the workman and his employer. The business of mining is one of constant research, and of experiment, and the greater the portion of skill and intelligence you can enlist into the service, the better the chance of success.

I have spoken of the ability of the mining agents, and no one is more willing than myself to appreciate and acknowledge it; but if to their aid we can call the thought and observation of numbers of men daily interested in minute investigation, we put a powerful instrument to work in our favour. The tribute system appears to me to do this, and I know that it has been doubted whether many of the mines of Cornwall could be continued to work, were it lost or abandoned.

The veins in a mine are explored by shafts, levels, and winzes, and while a knowledge of the mineral content is thus obtained, the ground is divided into portions, which may be conveniently allotted to be worked by gangs of men, who form each a partnership or pair, in the language of the mines, and which may consist of from two to twelve partners. These men undertake to dig the ore, raise it to the surface, and dress it fit for the market at a certain proportion of the amount for which it may sell. The agreements are made at so much out of every pound sterling, and the proportion will vary for 6*d.* in the pound, or less, to 13*s.* or 14*s.*, many circumstances having to be taken into account in making the calculation, such as the richness of the vein, the hardness of the rock, and so on.

The men pay for every article they use in their work, such as tools, gunpowder, and candles, and they pay at certain rates for the use of the machines that raise it to the surface, and the wages of all persons employed in washing and preparing the ores for sale.

Now in this manner the mine-owners, having by their capital and the skill of their agents discovered the ore, formed approaches to it, drained off the water, and ventilated the places for working, admit co-adventurers for a time, whose interest it is, not only to search out every piece of ore that can be profitably worked, but so to detach it from the matter with which it is mixed, as to incur the least possible expense in after processes.

The payments they make, cause them to look with a jealous eye on all cost incurred by others through whose hands the ores may pass, and thus to tend to a general economy, and, perhaps, above all, discoveries are much extended by speculation among the men, who risk their labour only while they bring into play the judgment, which the habit of constant observation enables them to form.

The earnings of tributers vary very much, as in cases where the prospect of success is small, a high rate of tribute is often given, and then a fortunate discovery may produce a large reward for the month or two that the bargain is made. The employer can well afford this, as he has all the benefit afterwards; and, besides, it is universally found, that the good luck of one set of men operates to reduce the general rate of wages, by encouraging more eager competition, and it further excites others to make experiment in places which otherwise might be overlooked.

I am aware that it may be said, that it is an old practice, and a usual one, in mines not in Cornwall, to pay men according to the quantity of ore they can raise, and that this differs but little from the tribute system. It would be easy to point out many differences, and which are greatly in favour of the latter, but these need not now be discussed.

Next to the improvements in the methods of exciting the energy of the men by the kind of agreement made with them, are those by which their labour is facilitated, and their work is rendered as convenient as possible. This is a subject which has of late years worthily occupied the attention of the best mine-managers; much has been done, and much remains to do. The ingenious invention which I described in a former lecture for carrying the men safely up and down deep mines, is of this kind, and which, I hope to see applied.

We must consider how important each little saving becomes, when it is multiplied by the great number of persons who are employed, and to all of whom it may apply.

One of the greatest modern improvements relates to the disposition of the men underground, and its design is, to place them so that the operations of one set are not to be interrupted by those of others; and, further, that the casualties occurring by the rise of the water, or other circumstances, may affect the least possible number. This result has been obtained, and in doing so, the form of our mines has undergone a considerable change, which will best be understood from a diagram.

Many accommodations are now provided for the work-people, which were not heretofore much attended to in England, though in Germany, it should be stated, that this was always a subject of attention; the winter climate in the mining districts there being more severe, and the men being a more feeble race generally than ours.

Whoever inspects a large mine in Cornwall will now observe, that for the persons who work on the surface, a great proportion of which are young women, sheds are provided, to protect them from the weather, and thus to allow their labour to proceed without interruption; and for the underground men there are convenient ranges of cabins, in which they may change their usual apparel for the dresses they wear in the mine, and where their tools and materials are safely deposited under lock. In some concerns provision is made for drying their underground clothes, so that when they require them they are ready, in a warm and comfortable state.

Medical attendance for the miners and their families is provided under the superintendence of the principal agents, and is paid for out of a fund, raised by a small monthly contribution by the men, and the same fund also furnishes relief to those who are suffering from accidents to which the miner is liable.

Due attention is paid, by persons appointed to the duty, to the state of the ladders, so as to keep them in a safe and convenient condition; and, generally speaking, this part of the management of mines is better understood and more regarded than formerly.

There is another point in mining economy, which is quite unconnected with the subject of the preceding observations, but it is an important one; and as it is not yet so fully appreciated as it ought to be, I would offer a few remarks upon it. It is the saving of time and expense which may be made, by the proper use of the steam-engine, or other machinery, in coming to the proof of the productiveness of mines.

In my former lecture I described the use of adits in draining mines, showing that they could be effective only to depths which the structure of the country allowed to be attained, and that to follow the veins to greater depths, either new adits, proceeding by great lengths of tedious and costly excavations, must be resorted to, or we must avail ourselves of the powers which steam and other machinery supply.

With many persons, and in some districts where mechanical arts have not made so much progress as in others, there is still a great predilection for adits; and the argument used is, that after the adit is made it costs nothing to drain the water, which runs freely through it. It seems, however, to be forgotten what the cost may be of executing such a work, and how that cost is swelled by the time occupied. I will illustrate this by a case or two. In the manor of Alston Moor, in Cumberland, the Nent-force level, which is an adit of considerable length, was commenced many years ago, when Mr. Smeaton was one of the Receivers for Greenwich Hospital, to which establishment the property belongs. The object was chiefly to prove whether the lead veins, which had been very productive in upper beds of rock, would be equally so in deeper strata. The veins are numerous in the district through which the level passes, and in the state of knowledge of the time, the plan was well devised, and the prospect of success was sufficient to warrant the enterprise. This great work was commenced in 1776, and, consequently, has been more than sixty years in driving—its length is more than three miles; the expense has been about 75,000*l.*, without interest, and it has not yet reached the veins, which it is most desirable to explore in depth, though they will now shortly be approached. The depth is about sixty fathoms from the surface, and not much above thirty deeper than the present workings. Hitherto the result has been unfortunate; many veins have been intersected, but the deeper beds of rock are not metalliferous, and so little has been discovered by the level, that, in 1823, when I was appointed to the inspection of these mines, it was a question fully discussed whether to abandon its prosecution, although so much had then been expended upon it.

Now, it is clear, that if we had now to make a similar trial, we might, by steam power, sink even to a greater depth upon some of the most promising veins, and that, in two or three years at the most, we might have decided the question at a very moderate cost; and supposing the result to be the same, that the mines were found not worth the pursuit in depth, that then, after selling the engines and the pumps, the amount of loss would be comparatively trifling. But allow that valuable discoveries had been made, who will say that the mode of drainage is a cheap one, of which the first cost has been 75,000*l.*, to which should be added the accumulated interest for sixty years.

The lead mines on Grassington Moor, in Yorkshire, are the property of his Grace the Duke of Devonshire. In the year 1818 I undertook the management of them, and I found a somewhat similar adit driving; this had been going on for about twenty years; had passed through a considerable space without making any important discovery: it was still distant from several mines, which had been formerly productive, and all working upon them had long ceased, and they were in a dormant state, waiting for this level, which was to drain them to the depth of about seventy fathoms. I collected together some small streams of water into extensive reservoirs, erected a water-wheel of fifty feet in diameter, and in two or three years the mines were actively working, and some of them were profitable, and contributed to the completion of the adit, which, having proceeded so far, I did not like to abandon. If the mines had waited for it, many years would have been lost. But there are cases in which it may be doubted whether an adit is of any adequate service, to justify the expense of making it. All mines require the command of water on the surface for washing the ores, and for want of it great expense is often incurred in carrying the ores to valleys or places where streams can be obtained. The cost of pumping the water from the level of the adit is then compensated by the use of it, at the very spot where the ores are delivered on the surface.

The great adit in the parish of Gwennap, in Cornwall, shown in Mr. Thomas's map, of that important mining district, extends with all its ramifications to more than thirty miles. It receives the water raised by many steam-engines, and discharges it from thirty to fifty fathoms below the surface; but, for the reasons I have stated, a proportion of the water is not suffered to escape into the adit, but is pumped to the surface to be there employed. The total quantity of water lifted from the mines to which this adit is connected, is about 4000 gallons per minute, by fourteen steam-engines, of great power, and the height to which it is raised is about 200 fathoms, to do which 32,000 bushels of coal are consumed monthly. But as a part of this coal is consumed now, in raising a proportion of the water to the surface, I believe we may assume, that as the depth of the adit is but one-fifth of the depth below it, that an expenditure of 4000 bushels of coal per month might deliver all the water without any adit at all; and if this should incur an expense of 3000*l.* to 4000*l.* a-year, payable only while the mines were working, can that be compared with a capital, sunk many years ago, in executing such a work as this, not to mention that a constant outlay is incurred in keeping the level in due repair.

Adits are recommended as modes of trial, by exploring the country through which they pass, and thus a use of them, under certain circumstances, may be advisable, though it is certain that that in Gwennap, one of the richest known mineral districts, passed through veins of great value, without discovering any of their treasures; and it has been mentioned that those in Alston Moor and Grassington, both great mining fields, were equally unsuccessful.

One of the most interesting trials, by means of an adit now in progress, is that at Real del Monte, in Mexico, and it is of this that Humboldt is reported to have said, that, "if executed, it would require that a new mint in Mexico be erected." Without expecting so much, there are, however, circumstances to justify the gradual expense of its progress, and particularly as the prosecution of the works on the most important mines are not delayed on account of it, but are vigorously pursued by the aid of steam power.

I do not know of any striking improvements in mining, which may be said to have been derived from the progress that geological science has made in later years; indeed, hitherto geology has rather been indebted to mining than mining to geology; but considerable attention is paid by our best practical miners to the structure of the rocks, and they deduce from this many observations, which aid them in their judgment in the most difficult part of their business—the due estimate of circumstances and appearances, which may encourage or deter expensive trials.

To chemistry, mining owes much, for the processes by which the ores are reduced, and the metals extracted from them, and there are improvements in this department recently perfected, and others are proposed, which are very important. This is, however, the province of metallurgy, which, besides being in this country a branch distinct from mining, is too large a field now to enter upon. I shall, therefore, barely mention, that the invention of a blast of hot air, which has been so successfully used in many iron-works, I have of late found equally useful in one part of lead smelting, and so as to lead to the conclusion, that it will be an important improvement in all cases where blast furnaces are employed.

Another very valuable invention, by Mr. Pattinson, of Newcastle, enables us to separate silver from lead, avoiding much of the loss of the latter, incidental to the common process. By a slow cooling of the melted lead, it is made to crystallize, and the crystals are separated from the part that remains in a fluid state. They are found to be nearly free from silver, which remains in the other part, and thus is concentrated in a small portion of the original mass. This small portion is exposed to the waste that occurs in cupellation, instead of the whole, and by this process, so small a proportion as four or five ounces of silver in a ton of lead, will pay for extraction.

The rapid steps with which the knowledge of the power of electricity, as a chemical agent, have lately advanced, lead to the belief, that we may derive from this source very powerful aid in metallurgic arts, and it is already understood, that M. Becquerel, who led the way in some of those experiments which have excited so much attention, has devised means of reducing some of the metallic ores, which are the most difficult of treatment, and that means may be found of so applying this discovery to practice, as materially to economize the reduction of some of the precious metals.

In the two discourses which I have had the honour to address to you, I have attempted to show that there is a large circle of knowledge, which ought to be possessed by those who direct the affairs of mines; and there are yet other subjects which I have not touched upon. It is not to be expected, nor is it necessary, that an intimate acquaintance with all these branches of science should rest in one individual. A division of labour in this, as in other things, may be a better thing. Still, it must be surely most desirable, that the means of instruction be afforded to the miner, as well as to other classes who are called upon to practise useful arts.

I have alluded to the mining colleges on the continent of Europe, and it is to be regretted, that this country, the mineral riches of which are more than double those of all Europe besides, is yet without any school where its miners may find a suitable education. It is clear, that from such an establishment, properly constituted, many other branches of industry might derive benefit, and that many of the lessons which the miner should be taught, would be useful to the civil engineer and other practical men.

There is a growing desire in the public mind, that this want should be supplied, and I know that many of high station in the country have it much at heart, and I doubt not, that in due time some good result will ensue.

Having this in view, and having in my former lecture dwelt entirely upon the physical part of the subject, I have ventured in this to suggest other topics, leading to the conclusion, that in any perfect plan of education, we must not be content with that relating merely to mechanical science, but that it would be incomplete without the views that are opened by political economy, and the studies connected with it are laid before those who must be required in their practice to act upon its precepts, and to whom it must be most important that their judgments are based upon sound principle.

ADDRESS TO THE GEOLOGICAL SOCIETY,

DELIVERED AT THE ANNIVERSARY, BY CHARLES LYELL, JUN., ESQ., PRESIDENT.

[*Continued from page 52.*]

It is certainly the safer course to incline to this hypothesis whenever there are no unequivocal signs, as in the Purbeck strata in Portland, of land plants having become fossil on the very spots where they grew. For although there may be many river deltas, like that of the Indus, where the land is subject to be alternately upheaved above, and then let down below the waters of the sea, yet such oscillations of level must be considered as exceptions to the general condition of the earth's surface near the mouths of rivers at any given period. Even in a case like the delta of the Indus, both the causes above alluded to may be expected to co-operate in producing alternate fluviatile and marine strata; for in the long intervals between great movements of the land, the river will annually advance upon the sea with its turbid waters, and then retreat again as the periodical flood subsides, and the salt waters, after being driven back for a time, will reoccupy the area from which they have suffered a temporary expulsion.

In the conclusion of his valuable paper, Mr. Prestwich observes, that the carboniferous strata of Coalbrook Dale must once have been entirely concealed under a covering of new red sandstone, and they owe their present exposure partly to those movements which have shattered and elevated the coal-measures, and partly to extensive denudation. It is natural, therefore, to inquire how many other coal-fields may still lie buried beneath the new red sandstone of the adjoining district.

In relation to this point of great practical importance, Mr. Murchison formerly offered some conjectures, when speaking of the probable passage of the ten-yard coal of the Dudley field, beneath the new red sandstone, which there flanks it on the east and west. That geologist now informs us that his conjectures have been verified, and that at Christchurch, one mile beyond the superficial boundary of the coal-field, the ten-yard and other seams have been reached by borings carried down to the depth of nearly 300 yards. Adverting to this discovery, he directs attention to the possible extension of other carboniferous tracts beneath the surrounding new red sandstone of Shropshire, Worcestershire, Staffordshire, and other central counties.

It is clear that these geological considerations must be duly weighed by those who speculate on the probable future duration of British coal, according to the actual or any assumed rate of consumption.

Mr. Murchison, in describing the Dudley and Wolverhampton coal-fields, informs us that he has not yet found any fossil remains of decidedly marine origin, like those observed by Mr. Prestwich in Coalbrook Dale. The shells seem to be all of fresh-water genera, and the *Megalichthys Hibberti*, and other fish occurring at Dudley, of species identical with those of the coal measures of Edinburgh, may have inhabited fresh water.

The same author has coloured on an Ordnance Map the superficial area of the Silurian rocks, connected with the coal-fields above mentioned, and has shown that the Lickey quartz rock, between Bromsgrove and Birmingham, of which the geological position has remained hitherto uncertain, is in fact, nothing more than altered Caradoc sandstone, a member of the lower Silurian group. The same appears as a fossiliferous sandstone in one district, while in another, it passes into a pure quartz rock, a modification attributed to the proximity of underlying trap, for analogous changes have been seen at neigh-

bouring points where the absolute contact of the sandstone with the trap is visible.

We are also indebted to Mr. Murchison for some interesting remarks on the dislocations of the strata in the neighbourhood of Dudley, and particularly for a description of some dome-shaped masses, from the centre of which the beds have a quâquâversal dip. He speculates on the probable dependence of these phenomena upon the protrusion of volcanic matter from below, at points where it has been unable to find issue. It would, I think, have been more satisfactory, if, in confirmation of his theory, some natural section of one of these dome-shaped masses could be pointed out, where not only a nucleus of trap was apparent, but could be shown to have taken up its actual position in a soft or fluid state. Even if we should find in some instances a subjacent central mass of trap, porphyry or granite, not sending out veins or altering the strata, the folding of the beds round such a protuberance might admit of an explanation like that suggested by Dr. Fitton. He has supposed a set of yielding horizontal strata to be pressed upon by a subjacent hill or boss of hard rock, in which case the effect of upward pressure might resemble that seen, on a small scale, in the paper of a bound book, where a minute knob in one leaf has imparted its shape to a great number of other leaves without piercing through them*. Whatever hypothesis we favour, it is essential to observe that such hills as the Wren's nest near Dudley, and others of similar ellipsodial forms and internal structure, do not correspond to the type of volcanic hills, such as Etna, Mount Dor, or the Cantal. In both cases there may be an approach to a cone, and the beds may dip everywhere outwards from a common centre; but in the volcanic mountain, the beds having an outward dip, thin off as they approach the base or circumference of the cone, which is not the case in inclined beds composing the hills alluded to in the neighbourhood of Dudley; nor in the last-mentioned instances do the lowest or subjacent rocks crop out round the circumference of the cone, as happens in the instance of the volcanic eminences before alluded to, where the granite of the country round Mount Dor, the fresh-water beds and mica schist in the Cantal, the marine deposits around Mount Etna in Sicily, each appear at the surface as soon as we have left the slope of the cone, and advance upon the surrounding low country.

In attempting to explain the principal transverse faults of the Dudley coal-field, Mr. Murchison refers frequently to the theoretical principles expounded by Mr. Hopkins, in his "Researches in Physical Geology," a paper printed in the 6th volume of the "Transactions of the Cambridge Philosophical Society." Mr. Hopkins has there endeavoured to develop, by reasoning founded on mechanical principles, and by mathematical methods, the effects of an elevatory force acting simultaneously at every point, beneath extensive portions of the crust of the earth. He is aware that in nature such a force must usually act under complicated conditions, so as to produce irregular phenomena; but he observes, that in order to have a clear conception of the manner in which it would operate in producing movements and dislocations, it is useful to assume certain simple conditions to which mathematical investigations may be applied. When we have deduced in this manner some results free from all uncertainty, these may serve as standard cases to which the geologist may refer more complex problems. Thus, for example, a portion of the earth's crust may be assumed to be of indefinite length, of uniform depth, and bounded laterally by two vertical parallel planes, beyond which the disturbing force does not extend. It is then supposed that a quantity of subterranean vapour or melted rock, existing at a certain depth, is expanded by heat so as to elevate the superincumbent mass, the resulting fissures in this mass may then become matters of calculation. According to Mr. Hopkins, rectilinear lines of dislocation will give rise to a set of longitudinal parallel fissures, and simultaneously to others precisely at right angles to them; whereas in conical elevations, the fissures will diverge from a centre. If the general axis of elevation be curvilinear, the longitudinal fissures preserving their parallelism with it will be also curvilinear, while the transverse fissures being perpendicular to the former at their points of intersection will no longer be parallel.

To return from this digression, I must now recall your attention to other papers relating to the carboniferous deposits of England. The coal-measures of the north-western coast of Cumberland have been examined by Professor Sedgwick and Mr. Williamson Peile, who have described the Whitehaven and other fields in great detail, illustrating their account with a map and sections. The recorded observations in numerous sinkings and borings, both in relation to the succession of the strata and to the complicated faults which intersect them, would have been involved in hopeless confusion, if they had simply consisted of a statistical collection of facts attested by miners; but in this paper, Professor Sedgwick, aided by Mr. Peile's practical and scientific knowledge, has compared the different sections, and generalized the phenomena, giving unity and consistency to the whole, throwing the strata into distinct groups, and referring the several faults to different movements to which successive periods of time may be assigned.

In connection with these recent contributions to the history of our carboniferous strata, I am happy to mention the excellent volume lately published by Professor Phillips, forming the second part of his "Illustrations of the Geology of Yorkshire." It is almost entirely devoted to a description of the carboniferous or mountain limestone of Yorkshire and the North of England, a subject already admirably treated in some papers read before this society by Professor Sedgwick, particularly in his account of the carboniferous chain from Penigent to Kirkby Stephen†. As these geologists had separately explored the same ground, it is satisfactory to perceive that the leading divisions which they have proposed for the classification of the mountain limestone and associated strata, agree in every essential point. Mr. Phillips has described the physical geography of the district occupied by these rocks, their lithological character, stratification, jointed structure, and the most remarkable faults which affect them, especially those which have been called the great Penine and Craven faults. He also treats of the trap dykes which cut through the limestone, and discusses the probable epochs of the displacement of the strata, judiciously pointing out the difficulties unavoidably opposed to the rigorous determination of the date of such dislocations. A large and very valuable portion of the work is filled with descriptions and plates of organic remains, especially of the brachiopodous and cephalopodous mollusca. Most of the species of these classes were probably inhabitants of the deeper parts of the sea, but there are fossil shells in the mountain limestone, which the author supposes to have lived near the shore, and belonging to genera formerly regarded as foreign to the carboniferous limestone, such as isocardia, nucula, pecten, patella, turritella, and buccinum. Many species of zoophytes and crinoidea are also described and figured in this excellent monograph.

We are indebted to Mr. Austen for a description of the south of Devonshire, between the river Ex and Berry Head, and between the coast and Dartmoor, a district consisting of transition rocks, new red sandstone, greenstone, and trap. His speculations on the origin of the different formations, and the causes which gave rise to the existing features in the physical geography of the country, display much talent and are full of instruction.

The structure of Devonshire has also furnished a fertile field of inquiry to Messrs. Sedgwick and Murchison since our last anniversary. They have attempted the difficult task of establishing a classification of the older rocks so largely developed in that county. In every geological map hitherto published of Devonshire, all the stratified deposits of higher antiquity than the new red sandstone had been represented by one common colour, the limestones being all included as integral parts of one great formation called greywacke.‡ But these gentlemen, after examining this region, announced at Bristol to the geologists assembled at the meeting of the British Association, that the great mass termed greywacke, and previously undivided, comprised in it several formations of great thickness, ranging in age from the Cambrian system of Professor Sedgwick up to the true carboniferous series inclusive. The first groups mentioned by them in ascending order are the Cambrian and Lower Silurian, which great mass contains many distinct courses of limestone; and is separable into several formations, distinguishable from each other by stratigraphical position and by lithological and zoological characters.

There appears, however, to be a great hiatus in the succession of rocks in Devonshire, as compared to South Wales, there being no traces of the upper Silurian strata, nor of the old red sandstone, nor even of the mountain limestone in its ordinary aspect. On the contrary, the next group met with in ascending order, is a culmiferous series, the base of which distinctly reposes upon the above-mentioned ancient rocks. This culmiferous deposit, far from appearing as a mere band, or at detached points, occupies about one-third of the large county of Devon, and a considerable adjacent part of Cornwall; its southern boundary, ranging from Exeter on the east, by Launceston to St. Gennis, in Cornwall, on the west; its northern frontier running by Barnstaple and South Moulton to near Wellington, in Somersetshire. These culmiferous beds are shown to contain thick beds of limestone, entirely dissimilar in structure and fossil contents from any limestones of the underlying "grauwacke," in which they had previously been merged. The culm measures consist of grit, sandstone, shale, and limestone; and these rocks, it is said, are never affected by a slaty cleavage, like the lower Silurian and Cambrian rocks on which they rest. From this character, as well as from their prevailing mineralogical structure and imbedded fossil plants, the authors regard the culmiferous formation of Devon as perfectly identical in age with other coal-fields, and as more particularly analogous to the culm-bearing strata of Pembrokeshire; a part of which also once passed for "grauwacke," but Mr. Murchison has recently shown that it belongs to the South Welsh coal-field, which is known by all geologists to rest upon mountain limestone.

Thus referred to the age of our ordinary coal, these strata of North Devon are further proved to lie in a great trough, their southern edges being turned up against the granite of Dartmoor, where they acquire, in contact with the granite, when traversed by elvan dykes, many characters of the metamorphic rocks, or those commonly termed primary. The phenomena of interference and alteration at the junction are such as to give a comparatively modern date for the eruption of the Dartmoor granite, and to explain why so much difficulty and ambiguity has prevailed in determining the age of some of the altered culm beds.

Among other points which this survey of Professor Sedgwick and Mr. Murchison has settled, so far as Devon is concerned, is one of the highest theoretical interest, and on which for more than two years the Society has been anxiously desiring more accurate information; I allude to the true stratigraphical position of certain shales near Bideford in North Devon, containing fossil plants of the same species as those which are found abundantly in the coal. I may first remind you that a discussion had previously arisen respecting the alleged discovery by Mr. Weaver of anthracite, with the usual carboniferous plants, in the greywacke or transition rocks of Ireland.* Notwithstanding the value justly attached to the opinion of so experienced and long-practised an observer, your council hesitated to print his statement, and requested him to re-examine the ground. At the same time Mr. Griffiths, to whom we are looking for the publication of a Geological Map of Ireland, had come to a different conclusion, and Mr. Weaver having been induced to repeat his observations, became convinced that he was in error, and has since studiously availed himself of every opportunity of announcing this change in his views.

You are aware that, as yet, in the British islands scarcely any vegetable impressions have been met with in rocks more ancient than the carboniferous strata above the old red sandstone, so that we know not what species of plants belong to the greywacke or transition group. We can only presume, from analogy, that since the shells, corals, and other organic remains of that ancient group, differ from those found above the old red sandstone; the plants also, if ever discovered, will differ as greatly. Considerable surprise was, therefore, excited when, during the presidentship of my predecessor in this chair, a letter was read, addressed to him from Mr. De la Beche, stating that he had found, near Bideford, in North Devon, many well known coal plants in the lower greywacke, or far down in the transition series.† Such of the plants as were determinable had been identified by Professor Lindley with species characteristic of the true coal-measures, and which had never been found elsewhere below the coal. The anomaly, therefore, in the supposed position of these fossils was so great, that between the ordinary geological site of such remains, and that in which they were here inferred to present themselves, there would be interposed, if the series were complete, the whole of the old red sandstone, and at least the two upper formations of the Silurian system. When this point was considered, I expressed to the Society my opinion, in common with Mr. Murchison, as to the insufficiency of the proofs relied on by our foreign secretary, and we felt that we had a right to call for more conclusive evidence. The simple fact of shales having been found charged with true coal plants, raised so strong a presumption in favour of their belonging to the regular carboniferous series, that the burthen of proof rested with him who wished to assign to them either a higher or lower position. Our scepticism was regarded by Mr. Greenough as implying too marked a bias for preconceived theory, and this he afterwards hinted in his anniversary address.‡ I may affirm, however, that in the first place it implied, on my part, no distrust of Mr. De la Beche's skill or experience in geological surveying, and that had Professor Sedgwick and Mr. Murchison advanced a similar opinion on analogous proofs, I should equally have withheld my assent. Suppose, for example, they had announced to us that they had found fossil fruits and leaves identical with those of Sheppey, in strata of the age of the white chalk with flints. I should have demanded from them, in corroboration, the most clear, unequivocal, and overwhelming evidence. If it were a region of disturbed and vertical strata, I should expect them first to have resorted in vain to every hypothesis of inverted stratification with a view of explaining away such an exception to the general rule.

I might, perhaps, be told that we are unacquainted with the flora of the upper cretaceous period, and I admit that we are as ignorant of it as of that which belonged to the transition period, but when we consider the contrast of the shells and other fossils of the chalk and London clay, we naturally anticipate that if plants are ever found of the precise age of our chalk with flints, they will not prove to be of the same species as those of the Sheppey clay. There is a like presumption from analogy against the conclusion that the same vegetation continued to flourish on the earth from the period of the lower greywacke to that of the coal, because we know that in the course of the intervening epochs the testacea, zoophytes, fish, and other classes of organic beings were several times changed.

In regard to the proofs relied on by Mr. De la Beche, I should observe, that he never attempted to show that the plant-bearing shales at Bideford were interstratified with rocks charged with shells or other fossils known to belong to rocks older than the old red sandstone.

Since writing the above sketch of the different views recently published of the structure of Devonshire, I have received a letter from Mr. De la Beche, from which I am happy to learn, that it is his intention before concluding his report on the Ordnance Map of Devon, to re-examine Devonshire. He is far, he says, from pretending that his first views were perfect, and if he finds reason to modify any of them, he shall not hesitate to announce the change of opinion. In the meantime, he no longer contends, that the culmiferous strata are referable to the lower greywacke, and considers the point of difference to lie within a narrower compass, namely, whether the culm beds are to be considered as upper greywacke or coal. This question, on which he is not yet satisfied, evidently appears to him of much less theoretical importance than, I confess, it does to me. It is fair, however, that I should state the arguments which influence his mind. If the plants, he says, found at Bideford in the culmiferous series should belong to strata more ancient than the old red sandstone, the fact would not stand alone, for he has lately received a letter from M. Elie de Beaumont, detailing analogous phenomena in Britanny. It is stated that the greywacke there closely corresponds in general character with that of Devon, the upper part like the Devonian series, containing anthracite. With this anthracite, or culm, are found at Montrelais, Chatelaison, and other places, fossil plants, the greater part of which are identical with those in the coal-measures; but there are others which have not hitherto been detected in the latter rock. Patches of true coal-measures rest in unconformable position upon these upper greywacke beds of Britanny. Now I regret that I have not seen any printed account of the geology of this part of France; for, until we learn whether the plants in question are associated with true Silurian fossils, the testimony is quite incomplete. We know not, for instance, whether the plant-bearing series in question is old red sandstone or a Silurian formation; or, whether it is a lower part of the true carboniferous system, of which the strata had been disturbed before a higher portion was superimposed.

Similar remarks hold in regard to the observations made by M. Virlet in the "Dictionnaire d'Hist. Naturelle," where in his late article "De l'Origine des Combustibles Minérelle," he speaks of certain carboniferous deposits of Ireland (those alluded to by Mr. Weaver before mentioned), as well as others examined by M. Voltz in the Black Forest; also, the culm beds of Britanny, and those of the department of La Sarthe, as all belonging in age to the newest transition formations, "*terrains de transition les plus récens.*"

Mr. De la Beche alludes to another discovery of coal plants, implying as great an anomaly as that which he had imagined to occur in Devonshire, and by which he was himself once led into error during an Alpine excursion, about eighteen years since, when he met with coal plants in the schists of the Col de Balme, in Switzerland. He then inferred that the beds belonged to the true coal-measures, but M. Elie de Beaumont afterwards proved them to be lias; that is to say, he identified them with other rocks not far distant in the Alps, which were shown to be lias, by containing belemnites and other fossils. Mr. De la Beche was at first sceptical on the point, but after revisiting the Alps, he came round to the same opinion. Having, therefore, been in one instance misled, by relying on the fossil vegetables of the coal as affording a good chronological test, he naturally attached but small value to the same testimony, as a criterion of the age of another set of rocks in Devonshire. Now you will easily understand, that a geologist who is once persuaded that the same plants flourished in European latitudes from the period of the true coal to that of the lias, will be ready to concede without difficulty the probable existence of the same plants at an era long antecedent to the coal. We know, that between the deposition of the coal and the lias there were successive revolutions in the races of animals which inhabited the waters, the zoophytes, mollusca, fish, and, as far as we know them, the reptiles having been changed again and again; so that the fossils of the mountain limestone differ from those of the magnesian limestone or zechstein; these again, from the organic remains of the muschelkalk, and these last from those of the lias. If we are to believe that the same plants survived on the land, while such fluctuations in animal life occurred in the waters, why should we not imagine the longevity of the same species to have been still greater, so that they began to exist even before the deposition of the old red sandstone? But let me remind you, that botanists have been led to very different conclusions respecting the laws governing the distribution of fossil vegetables from the study of undisturbed districts. You are not ignorant that the strata of the Alps are involved in extreme confusion and complexity, mountain masses having been completely overturned and twisted, so that the same set of strata have been found at the top and bottom of the same section, separated by several thousand feet of beds belonging to an older formation. So obscure is the order of position in Alpine geology, that the cretaceous and greensand series have been classed by experienced geologists as more ancient than the oolite, under which, in point of fact, they occasionally lie.

Professor Studer, in his work on the Bernese Islands, after years of personal investigation, has published a map, in which he has given a coloured ground plan without venturing to commit himself by sections, or a table of the regular order of superposition.

After devoting a summer to the investigation of the same portion of Switzerland, with the advantage of Mr. Studer's map and work, I was unable to satisfy myself that I had found a key to the classification or superposition of the formations, so enormous is the scale on which they have been deranged. I collected fossil plants on the Col de Balme, but I have not examined the precise localities further to the west, appealed to by M. de Beaumont. I am far, therefore, from denying his facts or inferences, hoping at some future period more carefully to inquire into the evidence on the spot. No one, I am aware, is more desirous that others should visit the southern Alps, and verify or criticise his facts, than M. de Beaumont. Meanwhile I am reminded of an expression of our mutual friend M. von Buch. When I related to him some geological phenomena which surprised him; "I believe it," he said, "because you have seen it, but had I only seen it myself, I should not have believed it."

But, to conclude, and to recall your attention to the structure of Devonshire, you will perceive that Mr. Murchison and Professor Sedgwick have endeavoured, and I think successfully, to work a great reform in the classification of the ancient rocks of that country, by applying to them the arrangement which they had previously made for the deposits termed by them Cambrian and Lower Silurian in Wales, and the adjoining parts of England. According to their survey and sections the coal plants of Bideford, so far from constituting any anomaly, so far from affording any objection to the doctrine that particular species of fossil plants are good tests of the relative age of rocks, do, in reality, from the place which they occupy, confirm that doctrine; for the culmiferous rocks distinctly overlie the so called grauwacke, and are not referable to any of the well defined and normal types, which compose the old red sandstone and Silurian system.

I shall now pass on to the consideration of other memoirs on English geology. The limestone which the Germans call muschelkalk, and the numerous fossils which are peculiar to it, have not yet been detected in England in any part of that great series of beds which intervene between the lias and the coal. In those parts of Germany where it occurs, it divides the beds of red marl and sandstone which occupy that great interval into two divisions, the upper of which is called keuper, and the lower bunter sandstein. In the absence of the muschelkalk in this country, it has been impossible for us to separate our new red sandstone into two well defined masses; but Dr. Buckland considers that certain portions of the upper beds in Warwickshire and elsewhere may be identified with the keuper by their mineral character, and near Warwick by the remains of a saurian, which he believes to be of the genus Phytosaurus, a genus characteristic of the keuper of Wirtemberg.

An examination in the south-east of England of the strata usually termed plastic clay, has led Mr. John Morris to offer several new, and as they appear to me, judicious suggestions, in regard to the classification of these beds. It is well known, that wherever the tertiary strata are seen in immediate contact with the chalk, they consist of alternations of sand, clay, and pebbles, and in some few places a calcareous rock; all these varying greatly in their thickness, and in their order of succession in different places. Mr. Morris divides those of Woolwich into two parts, and states, that the upper is characterized by a mixture of marine and fresh-water shells, the fresh-water genera being Cyrena, Neritina, Melanopsis, and Planorbis. The lower division contains exclusively marine shells. The author refers this intermixture to the influx of a river into the sea, in which the London clay was formed. Mr. Morris considers the Bognor strata, which rest immediately upon chalk, as the equivalents of the lower Woolwich deposit, observing, that the shells agree with those of the London clay. These remarks seem to confirm the conclusion to which he had been previously led by the grand section at Alum Bay, in the Isle of Wight, namely, that the beds usually styled plastic and London clays, belong to one zoological period.

MINERAL VEINS.

Your attention has been called to the origin of mineral veins by Mr. Fox, who has endeavoured to explain why so large a proportion of the metalliferous veins in England and other parts of the world, should have an east and west direction. He supposes fissures filled with water, containing sulphurets and muriates of copper, tin, iron, and zinc in solution, through which currents of voltaic electricity are submitted. The metals separated from their solvents by this action are deposited in the veins, and most abundantly in veins running at right angles to the direction of the earth's magnetism; for as the magnetic currents of the earth pass from north to south, they cause those of electricity to move east and west, although considerable deviations from this direction must be occasioned, in the course of geological epochs, by variations in the magnetic meridian.

Since Mr. Fox first ascertained the existence of electric current in some of the metalliferous veins in Cornwall*, Mr. Henwood has made many experiments on the same subject, together with observations on the distribution of metallic and earthy minerals in veins. He considers the results obtained by him to be, in a great degree, opposed to the theory of Mr. Fox†.

Mr. Fox conceives the fissures in which metalliferous substances occur, to have been at first small and narrow, and to have increased gradually in their dimensions. This doctrine has also been propounded in a work with which you are probably familiar, and from which I have derived much instruction, I mean M. Fournet's "Essay on Metalliferous Deposits." This Essay was originally included in the third volume of M. Burat's continuation of D'Aubuisson's "Treatise on Geology" (1835), but it is now published separately, and gives the clearest general view which I have seen of the application of geological theories to phenomena observed in mining. It is written by one who has acquired much practical knowledge as a miner, and who is well versed in chemistry and mineralogy‡.

Werner, when he published his justly celebrated "Essay on Mineral Veins," had come to the conclusion that the same rent, after being wholly or partially filled, has sometimes been re-opened; and M. Fournet has endeavoured more fully to explain the successive dilatation of the same veins at distinct periods. He has given examples in mines worked under his direction in Auvergne, in which the sulphurets of iron, copper, lead, and zinc, besides quartz, barytes, and other minerals, seem evidently to have been introduced at different periods by chemical action, accompanied by new fractures and dislocations of the rocks, and the widening of pre-existing fissures§.

You will find in M. Fournet's treatise a copious analysis of a great variety of books on mining, besides a detail of facts which have fallen under his own observation. He has described first, those veins which are decidedly connected with rents produced in rocks by mechanical movements, and which are supposed to have been chiefly filled from below by sublimation, more or less obviously connected with volcanic action. He afterwards passes on to the consideration of those masses which have been called stockwerks by the Germans, which are imagined by some to have their origin in the contraction of granite, porphyry, and other rocks as they cooled, numerous rents being then formed, in which metallic particles were concentrated. In treating the subject in this order, the author appears to me to have followed the most philosophical course, beginning with cases of undoubted rents of mechanical origin filled with minerals and metals introduced by sublimation, and then carrying with him, as far as possible, the light derived from these sources, to dissipate a part of the obscurity in which all theories respecting the nature of Plutonic rocks and their minerals, must, I fear, be for ever involved. Much will still remain unexplained; but those who proceed in an opposite direction, often throw doubt and confusion upon the simplest phenomena, as has sometimes happened in an analogous case, when geologists have begun with the examination of granite and granite veins, and have then endeavoured to apply the ideas derived from this study, to the trap rocks and volcanic dykes.

Among the most interesting conclusions deduced by M. Fournet from his examination of the mining districts of Europe, I may mention the modern periods at which the precious metals appear to have entered into some veins: thus, to select a single example, some veins of silver of Joachimsthal in Bohemia, are proved to have originated in the tertiary period‖.

FOREIGN GEOLOGY.

Among the researches into the geology of foreign countries in which our members have been recently engaged, I have great pleasure in alluding to the labours of Mr. H. E. Strickland, and Mr. Hamilton, in Asia Minor. These gentlemen first examined the neighbourhood of Constantinople, and found on both sides of the Thracian Bosphorus an ancient group of fossiliferous strata, consisting of schist, sandstone, and limestone. From the character of the fossils, it is inferred that these rocks may probably be the equivalents of the upper transition or Silurian strata of England. The shells belong to the brachiopodous genera spirifer, producta, and terebratula, with which the remains of corals and crinoidea were associated, and fragments of a trilobite.

The rarity of any fossiliferous deposits of higher antiquity than the old red sandstone in any of the countries bordering the Mediterranean, or indeed to the south of the Alps and Pyrenees, lends considerable interest to this observation. In their way through France, our travellers examined the well

* Dr. Fitton, Geol. Trans. 2nd Series, vol. iv. p. 244.
† Trans. Geol. Soc. 2nd Series, vol. iv. part I. p. 69.—1835.
‡ The Abstract of the Report of Messrs. Sedgwick and Murchison, published with ... the Athenæum, August, 1836, and in other scientific journals, is the ... written for insertion in the Proceedings of the Association. From that abstract, and from a written explanation of their views, which I obtained from the authors, the present observations are deduced.

* Proceedings Geol. Soc., vol. i. p. 231.
† Proceedings Geol. Soc., vol. ii. p. 106.
‡ Proceedings Geol. Soc., vol. ii. p. 164.

* Phil. Trans. 1830, p. 399.
† See *Mining Journal*, Supplement 9, p. 24, December 1836; and Annals of Electricity, No. 2, vol. i. on Electric Currents, &c., by W. T. Henwood, Esq.
‡ Études sur les Dépôts Métallifères, par M. I. Fournet.
§ See "Études," &c. Section 3.
‖ See "Études," &c., Section 2.

known region of extinct volcanos in Auvergne, and afterwards found a counterpart to it in the Catacecaumene, a district in Asia known by that name in the time of Strabo, from its burnt and arid appearance. Some of the volcanos in Asia are of very modern appearance, although no notice of their eruptions falls within the limits of history or tradition. The volcanic hills rise partly through lacustrine limestone, in the valley of the Hermus, and partly cover the slope of the schistose hills, which bound it to the south. There are about thirty older cones, worn by time, and of which the craters are effaced, or only marked by a slight depression; and three newer cones, which preserve their characters unaltered, the craters being perfectly defined, and the streams of lava still black, rugged, and barren. Here, as in the country of corresponding structure in France, we find streams of lava following the course of existing valleys, and yet frequently cut through by rivers. We find also, a tertiary fresh-water formation, sometimes resembling chalk with flints, like that of Aurillac in France, and forming detached hills capped with basalt, while more modern lavas have flowed at the base of the same hills. The extent of this analogy will be best appreciated by those who compare Mr. Strickland's drawings, with Mr. Poulett Scrope's masterly illustrations of the French volcanic region.

The countries watered by the rivers Meander and Cayster, are described as having a simple geological structure. There are granitic rocks, with saccharine marble, there are also hippurite limestone and schist, and tertiary deposits unconformable to these, besides igneous rocks of various ages. The tertiary formations are chiefly lacustrine, and occur in nearly every large valley. They are composed of horizontal beds of calcareous marl and white limestone, in which are layers and nodules of flint; they also consist of sandstone, sand, and gravel.

The only representative of the secondary rocks of Europe is termed by Mr. Strickland "hippurite limestone," which appears to be very sterile in fossils. In this respect, and in its other characters, it agrees with that great calcareous formation described by MM. Boblaye and Virlet, in their splendid work, on the geology of the Morea*. According to these French geologists three quarters of the Peloponnesus are occupied by a compact limestone several thousand feet thick, in which they could discover scarcely any organic remains, except a few hippurites and nummulites, but which is supposed to be the equivalent of our chalk and oolites. Nothing, they say, can be more monotonous in character, than this calcareous mass in the south of Europe, which appears to represent the larger part of our upper secondary formations of the north, where the rocks are so varied in lithological aspect, and so distinguishable from each other by their well preserved fossils.

Ancient fossiliferous strata, resembling those of the neighbourhood of Constantinople are said to be largely developed in the Balkan, a mountain chain of which we may soon expect to receive information from the pen of M. Ami Boué. That indefatigable geologist has already explored a large part of Servia, a country of whose physical and moral condition we are, perhaps, more ignorant, than of any other in Europe, and he is rapidly extending his survey over various parts of the Turkish empire, to the examination of which, he proposes to devote several years. Meanwhile, our late Secretary, Mr. Hamilton, is continuing, with great zeal, his investigation of the borders of the Black Sea, and other parts of Asiatic Turkey.

In a paper on the structure of part of the Cotenin near Cherbourg, the Rev. W. B. Clarke describes that country as consisting of hills or ridges of quartz rock alternating with valleys of slate, occasionally associated with syenite and greenstone, which appear to be of posterior origin. A curious fact is mentioned: the quartz rock splits naturally into irregular masses, which have, nevertheless, some angles of fixed dimensions, namely, 103°, 64°, and 83°. Fragments of a green variety of schist exhibit the same angles under the same circumstances of position, proving that similar causes had acted on the two formations *en masse*, the same sets of joints, lines of stratification, and cleavage, being found in both. Besides these facts, which are illustrated by diagrams, the author mentions others calculated to throw light on the cleavage and jointed structure of rocks.

PROOFS OF MODERN ELEVATION AND SUBSIDENCE.

Under this head I shall first consider several notices of beds of gravel, sand, clay, and marl, containing recent marine shells, which have been observed in various parts of Great Britain, a subject very frequently brought before our notice of late years. Deposits of this kind have been found by Dr. Scouler in the vicinity of Dublin, where they rise to the height of eighty, and in some places of even 200 feet above the level of the sea. Besides marine shells of existing species, he has ascertained that some of the lower beds of this formation, contain bones of the extinct Irish elk, by which we learn that this quadruped, although belonging to a comparatively modern period, and found in peat-mosses, had nevertheless begun to inhabit this part of the world at a period anterior to some of the last changes in the position of land and sea, changes which are proved by the upraised shelly beds just alluded to. Now Professor Nilsson, of Lund, in Sweden, although ignorant of these facts, had remarked to me that some great alteration must have occurred in the shape and extent of dry land and sea in Great Britain and the surrounding parts, subsequently to the time when the Irish elk existed, otherwise, so many entire skeletons of so large an herbivorous quadruped as the *Cervus megaceros*, would not have been found in so small an island as the Isle of Man. That island may at no remote geological period, have been united to the main land, and may have since been separated from it by subsidences, on a scale equal to the elevations of which there is such clear evidence in Ireland and elsewhere.

Changes in the relative level of land and water, in the estuary of the Clyde, are indicated by facts described in another paper by Mr. Smith, of Jordan Hill, near Glasgow. Superficial deposits, in which a great number of marine shells of recent species are imbedded, are found on the banks of the Clyde below Glasgow, at the height of thirty or forty feet above the sea. I had myself an opportunity of veryfying during the last summer, several of these observations of Mr. Smith, and found equally clear proofs, that the island of Arran had participated in the upward movement, so that a circle of inland cliffs may be traced all round that island, between the base of which, and the present high water mark, a raised beach occurs, and in some places beds of marine marls, formed of recent shells, as in the bay of Lamlash. Mr. Smith has also traced sea-worn terraces on each side of the Clyde below Dumbarton, and between the Cloch Lighthouse and Largs.

We are indebted to Sir Philip Egerton for some new details respecting the shelly gravel of Cheshire, of which he had previously treated; and to Mr. Murchison and Professor Sedgwick, for a joint-paper on "a raised beach in Barnstaple Bay, on the north-west coast of Devonshire." This beach puts on for several miles where it is best exposed, the form of a horizontal under terrace, resting upon an indented and irregular surface of the older formations. It presents a cliff towards the sea, in which beds of calcareous grit, sandstone, and shingle are seen perfectly stratified. The bottom of the deposit is chiefly composed of indurated shingles resting on the ledges of the older rocks, and filling up their inequalities. Through the whole cliff, but especially in the indurated grits, shells are abundantly dispersed, identical in species with those now living on the coast, and well preserved, though sometimes waterworn.

The authors point out that these beds cannot have been formed by accumulations of blown sand. They demonstrate an elevation of the coast during the modern period; and there are phenomena, both on the north and south coasts of Devonshire and Cornwall, which afford proofs of modern changes in the level of the land, both of upheaval and depression. The raised beach of Hope's Nose, correctly described by Mr. Austen, is the most striking instance in South Devon.

The quantity of rise of land in the modern period is from ten to forty feet in South Devon and Cornwall, nearly seventy feet in North Devon, while in Lancashire, Cheshire, and Shropshire, there are marine deposits, with recent shells, at the height of from 300 to 500 feet above the sea.

It is natural to inquire, what changes the surface of the dry land in England may have undergone during the occurrence of such upward and downward movements. Perhaps some observations lately made by Mr. Bowerbank, in the south of the Isle of Wight, may elucidate this point. He has given us an account of a bed of chalky detritus, containing recent land shells, at Gore Cliff. This bed is ten feet thick, and rests immediately upon chalk marl. Many of the shells, which are plentifully scattered through it, retain their colour. As the deposit ranges to the foot of St. Catherine's Down, it is possible that the waste and denudation of that chalk hill may have supplied the materials. I have lately seen similar detritus resting on the chalk with flints, and arranged in numerous thin layers, in the section exposed in cutting the railroad at Winchester, where a black layer of peaty earth and carbonized wood intersects thin layers of white chalk rubble, from twenty to thirty feet thick. Such appearances are, in fact, very general in chalk districts; a bed of flints, not waterworn, occurring on the highest downs, while fragmentary chalk, often enclosing land shells, occurs on their slopes, and at lower levels. Violent rains have been known, even of late years, to tear off the turfy covering from certain points near Lewes, and to wash away flints and chalky mud, and leave them in the hollow combs or flanks of the hills. This action of the elements would be most powerful at periods when the chalk first emerged from the sea, or whenever it assumed, in the course of subterranean disturbances, a new position or physical outline.

We must, I think, infer, from the occurrence of certain recent marine shells and shingle in the bottom of what has been termed the elephant-bed, at Brighton, that the chalk in the south-east of England has undergone some movements of a modern date, the land having subsided there to the depth of fifty or sixty feet, and having been subsequently raised up again to a level somewhat higher than its original position.†

* Paris, 1833, in folio. It is to be regretted that this work cannot be procured separately from other folios containing the scientific information collected during the French expedition to the Morea.

† See Principles of Geology, 4th edit., vol. iv. p. 274.

If it should appear, upon careful research, that the land shells found in terrestrial alluviums, covering the chalk, are almost universally of recent species, I should not conclude that the emergence of the chalk hills from the sea, had generally occurred at a very modern period, but merely that these hills had been modified in shape in recent times, and that, during that modification, alluviums of older date had been washed away, or the land shells, which they may once have contained, have decomposed and disappeared. In regard to the great numbers of these shells preserved throughout the bed at Gore Cliff, and in many other places even at greater depths, it will not seem surprising to those who have observed the number of dead land shells which are strewed over the surface of the chalk downs, or lie concealed in the green turf, in numbers almost as countless as the blades of grass. If the slightest wash of water should pass over such a soil, it must float off myriads of these shells, and they would immediately be involved in that cream-coloured mud which descends from wasting hills of chalk after heavy rains. Land shells, so buried, may retain their colour for indefinite periods, as is shown by the state of species in the loess of the Rhine, and even in tertiary strata of much higher antiquity.

While a variety of geological monuments are annually discovered, which attest modern alterations in the level of the land, it is important to remark, that new testimony is also daily obtained of the rising and sinking of land in our own times. I discussed at some length, in my last Anniversary Address, the evidence for and against the upheaval of the coast of Chili, during the earthquake of 1822, a controverted point to which our attention has lately been again recalled. I may remark, however, that since we have ascertained the fact of a rise of three, five, and even ten feet in parts of the same country in 1835, so distinctly attested by Captain Fitzroy, all doubts entertained as to the permanent effects of a preceding convulsion are, comparatively, of small interest. Don Mariano Rivero dissents from the opinion that a change of level occurred at Valparaiso in 1822, and Colonel Walpole, after seeing the ground, and conversing with persons who were on the spot in 1822, and who still reside there, also considers the statement of a rise to have been inaccurate. On the other hand, Mr. Caldeleugh, who was formerly sceptical on the same point, has now come round to the opinion of Mrs. Callcott (Maria Graham), and believes that an elevation of land did take place.

Mr. Darwin, whose opportunities of investigation, both in Chili and other parts of South America, have been so extensive, thinks it quite certain that the land was upheaved two or three feet during the earthquake of 1822, and he met with none of the inhabitants who doubted the change of level. He states that the rise of land, even in the bay of Valparaiso, was far from being uniform, for a part of a fort, not formerly visible from a certain spot, has, subsequently to the earthquake, fallen within the line of vision. The most unequivocal proof of a recent rise is drawn from the acorn-shells, *Balanidæ*, found adhering to the rock, above the reach of the highest tides. These were observed by Mr. Darwin sixty miles south of Valparaiso, and at Quintero, a few miles to the north of it; but his friend, Mr. Alison, detected them on a projecting point of rock at Valparaiso itself. The attached shells were there seen at the height of fourteen feet above high-water mark, and were only exposed upon the removal of the dung of birds, by which they would have been concealed from ordinary observation. In Mr. Darwin's paper you will find many other facts elucidating the rise of land at Valparaiso, and he has also treated of the general question of the elevation of the whole coast of the Pacific, from Peru to Terra del Fuego. Beds of shells were traced by him at various heights above the sea, some a few yards, others 500, or even 1300 feet high, the shells being in a more advanced state of decomposition, in proportion to their elevation. Mr. Darwin also shows, that parallel terraces, such as those of Coquimbo, described by Captain Basil Hall and others, which rise to the height of 300 feet and more, are of marine origin, being sometimes covered with sea-shells, and they indicate successive elevations. There are also grounds for believing that the modern upheaval of land has proceeded, not only by sudden starts during convulsions of the earth, but also by insensible degrees in the intervals between earthquakes, as is now admitted to be the case in parts of Norway and Sweden.

This gradual and insensible rising is supposed to affect, not only the region of the Andes, but also the opposite or eastern coast of South America, where earthquakes are never experienced: for the Pampas of Buenos Ayres bear marks of having risen to their present height during a comparatively modern period, while the coast line of the Pacific, or the region of earthquakes and volcanic eruptions, has been the theatre of more violent movements.

It is curious to reflect, that if in one portion of a large area of the earth's surface a rise of land takes place at the rate of a few inches in a century, as around Stockholm, while in another portion of the same area, land is uplifted about a yard during an equal period, there will be caused, if sufficient time be allowed, a group or chain of lofty mountains in one place, and in the other a low country like the Pampas of South America.

Evidence of a sinking down of land, whether sudden or gradual, is usually more difficult to obtain than the signs of upheaval. I shall, therefore, mention some facts which have been lately communicated to me by Professor Nilsson, from which it appears, that Scania, or the southernmost part of Sweden, has been slowly subsiding for several centuries, in the same manner as was lately shown to be the case with part of Greenland. In the first place there are no elevated beds of recent marine shells in Scania, like those near Stockholm, and further to the north. Linnæus, with a view of ascertaining whether the waters of the Baltic were retiring from the Scanean shore, measured in 1749 the distance between the sea and a large stone near Trelleborg. Now, Mr. Nilsson informs me, that this same stone is a hundred feet nearer the water's edge than it was in Linnæus's time, or eighty-seven years before. He also states, that there is a submerged peat moss, consisting of land and freshwater plants, beneath the sea, at a point to which no peat could have been drifted down by any river. But what is still more conclusive, it is found that in sea-port towns, all along the coast of Scania, there are streets below the high-water level of the Baltic, and in some cases, below the level of the lowest tide. Thus, when the wind is high at Malmö, the water overflows one of the present streets, and some years ago, some excavations showed an ancient street in the same place, eight feet below, and it was then seen that there had evidently been an artificial raising of the ground, doubtless in consequence of that subsidence. There is also a street at Trelleborg, and another at Skanor, a few inches below high-water mark, and a street at Ystad is just on a level with the sea, at which it could not have been originally built. I trust that we shall soon receive more circumstantial details of these curious phenomena, which are the more interesting, because it has been shown that the elevatory movement in Sweden diminishes in intensity as we proceed southward from the North Cape to Stockholm, from which it seems probable, that after passing the line or axis of least movement, where the land is nearly stationary, a movement may be continued in an opposite direction, and thus cause the gradual sinking of Scania.

I cannot take leave of this subject without remarking that the occurrence in various parts of Ireland, Scotland, and England, of recent shells in stratified gravel, sand, and loam, confirm the opinion which I derived from an examination of part of Sweden; namely, that the formations usually called diluvial have not been produced by any violent flood or débacle, or transient passage of the sea over the land, but by a prolonged submersion of the land, the level of which has been greatly altered at periods very modern in our geological chronology. I now believe, that by far the greatest part of the dispersion of transported matter has been due to the ordinary moving power of water, often assisted by ice, and co-operating with the alternate upheaval and depression of land. I do not mean wholly to deny that some sudden rushes of water, and partial inundations of the sea have occurred, but we are enabled to dispense with their agency more and more, in proportion as our knowledge increases.

ORGANIC REMAINS.

Gentlemen, you have been already informed, that the Council have this year awarded two Wollaston medals, one to Captain Proby Cautley, of the Bengal Artillery, and the other to Dr. Hugh Falconer, superintendent of the Botanic Garden, at Saharunpore, for their researches in the geology of India, and, more particularly, their discovery of many fossil remains of extinct quadrupeds at the southern foot of the Himalaya mountains. At our last anniversary, I took occasion to acknowledge a magnificent present, consisting of duplicates of these fossils, which the society had received from Captain Cautley, and since that time, other donations of great value have been transmitted by him to our museum. These Indian fossil bones belong to extinct species of herbivorous and carnivorous mammalia, and to reptiles of the genera crocodile, gavial, emys, and trionyx, and to several species of fish, with which shells of fresh-water genera are associated, the whole being entombed in a formation of sandstone, conglomerate, marl, and clay, in inclined stratification, composing a range of hills called the Siwalik, between the rivers Sutledge and Ganges. These hills rise to the height of from 500 to 1000 feet above the adjacent plains, some of the loftiest peaks being 3000 feet above the level of the sea.

When Captain Cautley and Dr. Falconer first discovered these remarkable remains their curiosity was awakened, and they felt convinced of their great scientific value; but they were not versed in fossil osteology, and being stationed on the remote confines of our Indian possessions, they were far distant from any living authorities or books on comparative anatomy to which they could refer. The manner in which they overcame these disadvantages, and the enthusiasm with which they continued for years to prosecute their researches, when thus isolated from the scientific world, is truly admirable. Dr. Royle has permitted me to read a part of their correspondence with him when they were exploring the Siwalik mountains, and I can bear witness to their extraordinary energy and perseverance. From time to time they earnestly requested that Cuvier's works on osteology might be sent out to them, and expressed their disappointment when, from various accidents, these volumes failed to arrive. The delay, perhaps, was fortunate, for being thrown entirely upon their own resources, they soon found a museum of comparative anatomy in the surrounding plains, hills, and jungles, where they slew the wild tigers, buffalos, antelopes, and other Indian quadrupeds, of which they preserved the skeletons, besides obtaining specimens of all the genera of reptiles which inhabited that region. They were compelled to see and think for themselves while comparing and discriminating the different recent and fossil bones, and reasoning on the laws of comparative osteology, till at length they were fully prepared to appreciate the lessons which they were taught by the works of Cuvier. In the course of their labours they have ascertained the existence of the elephant, mastodon, rhinoceros, hippopotamus, ox, buffalo, elk, antelope, deer, and other herbivorous genera, besides several canine and feline carnivora. On some of these Dr. Falconer and Captain Cautley have each written separate and independent memoirs. Captain Cautley, for example, is the author of an article in the "Journal of the Asiatic Society," in which he shows, that two of the species of mastodon described by Mr. Cliff are, in fact, one, the supposed difference in character having been drawn from the teeth of the young and adult of the same species. I ought to remind you, that this same gentleman was the discoverer, in 1833, of the Indian Herculaneum, or buried town, near Behat, north of Saharunpore, which he found seventeen feet below the surface of the country, when directing the excavation of the Doab Canal.*

But I ought more particularly to invite your attention to the joint paper by Dr. Falconer and Captain Cautley on the Sivatherium, a new and extraordinary species of mammalia, which they have minutely described and figured, offering at the same time many profound speculations on its probable anatomical relations. The characters of this genus are drawn from a head almost complete, found at first enveloped in a mass of hard stone, which had lain as a boulder in a water-course; but after much labour the covering of stone was successfully removed, and the huge head now stands out with its two horns in relief, the nasal bones being projected in a free arch, and the molars on both sides of the jaw being singularly perfect. This individual must have approached the elephant in size. The genus Sivatherium, say the authors, is the more interesting, as helping to fill up the important blank which has always intervened between the ruminant and pachydermatous quadrupeds, for it combines the teeth and horns of a ruminant, with the lip, face, and probably proboscis of a pachyderm. They also observe, that the extinct mammiferous genera of Cuvier were all confined to the pachydermata, and no remarkable deviation from existing types had been noticed by him among fossil ruminants, whereas the sivatherium holds a perfectly isolated position, like the giraffe and the camels, being widely remote from any other type.

I have not space to enter upon the warm discussion which has arisen in France between MM. Blainville and Geoffroy St. Hilaire respecting the amount of analogy which exists between the sivatherium and the giraffe, but I observe with pleasure that in the course of that controversy those distinguished naturalists do justice to the zeal and talents displayed by our countrymen, Captain Cautley and Dr. Falconer, and to the services which they have rendered to science.

While these discoveries were made on the banks of the tributaries of the Indus and the Ganges, Mr. Darwin was employed in collecting the bones of large extinct mammalia, near the banks of the Rio Plata, in the Pampas of Buenos Ayres and in Patagonia. Mr. Owen has enabled me to announce to you, in a few words, some of the most striking results which he has obtained from his examination of the specimens liberally presented by Mr. Darwin to the College of Surgeons, and of which casts will soon be made for our own and other public museums. In the first place, besides a cranium with teeth of the megatherium, Mr. Darwin has brought home portions of another animal, as large as an ox, and allied to the megatherium. Fragments of its armour are preserved, as well as its jaws, femur, and other bones. There is also a third creature of the order Edentata, and belonging to this same family of Dasypodidæ, in the shape of a gigantic armadillo, as large as a tapir. Of the ruminant order there is also a no less remarkable representative in the remains of a gigantic Llama from the plains of Patagonia, which must have been as large as a camel and with a longer neck; and, lastly, of the rodentia there is the cranium of a huge animal of the size of a rhinoceros, with some modification in the form of the skull resembling that in the Wombat.

These fossils, of which a description will shortly be given to the Society by Messrs. Clift and Owen, establish the fact that the peculiar type of organization which is now characteristic of the South American mammalia, has been developed on that continent for a long period, sufficient at least to allow of the extinction of many large species of quadrupeds. The family of the armadillos is now exclusively confined to South America, and here we have from the same country the megatherium, and two other gigantic representatives of the same family. So in the camelidæ, South America is the sole province where the genus Auchenia or Llama occurs in a living state, and now a much larger extinct species of Llama is discovered. Lastly, among the rodents, the largest in stature now living is the Capybara, which frequents the rivers and swamps of South America, and is of the size of a hog. Mr. Darwin now brings home from the same continent the bones of a fossil rodent, not inferior in dimensions to the rhinoceros.

These facts elucidate a general law previously deduced from the relations ascertained to exist between the recent and extinct quadrupeds of Australia; for you are aware that to the westward of Sydney on the Macquarie river, the bones of a large fossil kangaroo and other lost marsupial species have been met with in the ossiferous breccias of caves and fissures.

[*To be concluded in our next.*]

GEOLOGY.

Has geology so far attained certainty as to qualify any man to dispute the authority furnished by the Scriptures? That question is easily answered by the man who feels the rational and perfect homage which is due to the direct language of inspiration. It will be not less easily answered by the man of mere common sense, who sees that, of all the attempts of human science, geology is, at this moment, in the crudest imaginable state—that its facts are totally undigested—that, eminently depending on experiment, it is still only in its experimental infancy—that a ten millionth part of the globe has not yet been thoroughly examined—that the structure of the globe is to be ascertained only in depths which have never been reached by man, and which seem to be expressly prohibited to man—that geology can know nothing beyond the mere crust of the earth, and yet knows but little even of that—and that even if more were known, the crust is no more in a fitting condition to assist the development of the earth's general fabric than the coat of a traveller, bespattered with mud, reveals the anatomy of the living, vigorous compound of bone and muscle, blood and brain, within. It is indeed remarkable, and, as if in ended as a direct rebuke to this modern presumption, that a new process in nature should be evolved in our days, expressly replying to the strongest part of the sceptical system. The anti-Scriptural arguments founded upon the deposit of shells on the summits of mountains, and their perfect preservation in beds of clay, have been readily and completely answered by a reference to the true language of the sacred record. The geologists, who certainly oftener attempt to refute than to read the Scriptures, triumphantly asked, could these deposits have been made by a furious inundation of a year? We answer no; but answer, at the same time, that the geologists had forgotten to observe that at least a third of the earth's surface, the present dry land, was made the bed of the ocean, in the first days of the creation, and continued in that state until the deluge, which submerged the existing land, and uncovered and raised the bed of the ocean—a fact evidently proved by the nature of the strata, and long since conceded by all geologists of name, but a fact which gave a period of 1500 years, or rather 2000 (according to the Septuagint chronology, which is the authentic one), for the formation and preservation of the deposits in the calm depths of the primeval ocean. But the grand objection was the slow formation of the minerals, gems, &c. Nothing under millions of years would be sufficient for this! Yet what has the truth turned out to be? It has been shown, since the last few months, that the force of electricity, acting on such simple means as water, can effect the process of making crystal, and this within a month, or even a week; that there is a fair prospect of being able to make some of the principal metals in as short a time, and that, by an increased action of the voltaic pile thus simply applied, even the hardest substance in nature, gems, may be brought within the limits of human manufacture. The whole question between geology and Scripture rests on this point. Does the geologist know the whole construction of the earth? No, nor any thing beyond a most imperfect survey of an extremely small portion of its surface? Does the geologist know all the powers by which nature works? No, not probably the ten-thousandth part of them. Then let him wait until he knows them, and let him speak humbly of himself in the mean time. Let him have the honesty to acknowledge his ignorance, and the good sense to speak with reverence of that revelation which is incapable of error, and which, so far as it has declared the physical construction of the earth and heavens, has declared it, not to feed the vanity, but to elevate the virtue of mankind.—*Blackwood's Magazine.*

IRON TRADE.—The Welsh masters have reduced the price of iron 1*l.* per ton.

* Journ. of Asiatic Society, Nos. xxv. and xxix., 1834. Principles of Geology, 4th and subsequent editions. See Index, Behat.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. VII.

ON THE ADVANTAGE OF USING A MIXTURE OF POWDER AND SAWDUST FOR BLASTING.

It has been frequently inquired, whether a mixture of powder with sawdust is preferable, in blasting, to powder alone? and the replies have been various, according to the influence of habit and prejudice, private interest, or want of perseverance in the necessary experiments. The saving of so expensive a material is, however, an important consideration in most mining operations; and although the increased effect appears unaccountable to many who have been used to avoid most carefully the mixture of any foreign substance with the blasting-powder, yet this effect may, I think, be explained, simply by the fact, that the wider diffusion or greater looseness of the powder, in consequence of the mixture, gives rise to a more immediate and general ignition of the whole mass.

When the holes are charged with powder alone, the powder cannot all ignite at the same instant, and, consequently, a part of it is without effect, for if a new piece of board be placed before a hole charged with powder alone, grains of powder, which have not become ignited, will be found after the explosion on the board. In order to contribute in some degree towards the more general adoption of this highly useful method, I may be allowed to present to the mining public the results of my experiments, begun in December, 1818, and continued several months, which fully convinced me that mixed powder is, in every case, applicable and advantageous; and, since that period, I have directed this mixture to be constantly used in these mines. The saving I have found to be, on an average, two-fifths of the former annual consumption. The powder used here is from the Stollberg mills—is proof at thirty to thirty-two degrees, and of a middling grain. Before using, it is dried as highly as possible; the sawdust undergoes a similar drying, but without causing it to lose its natural colour, or approach a state of carbonization: in other respects it is in the same condition as when first brought from the saw-mills. As the mixture, when packed in the ordinary powder-bags, does not continue in the same relative and equal position, in consequence of the component materials separating, by reason of the difference in their specific gravity, I make use of well tinned plate-iron powder-flasks, with a wide well-closed aperture, from which the men fill the cartridges by means of an iron or wooden spoon.

According to Mr. Varnhagen, the saving of powder in Brazil is three-fourths, which I think is hardly possible. I have made trials with this proportion, but no effect was produced; and I was therefore obliged to increase the proportion of the powder to two parts to one of sawdust in bulk, although, in many cases, I could only procure a satisfactory result by a composition of three parts of powder with one of sawdust. Not to offend the prejudices of the workmen, I added powdered charcoal to the sawdust, which answers the same purpose as the sawdust, but charcoal from soft wood is preferable to that from hard, since the former is more inflammable, spreads the powder more loosely, and does not explode in a regular tabular form, which would prevent the simultaneous and instant ignition of the grains of the powder. As it was the opinion of several authors that the evolution of gases, occasioned by the ignition of the sawdust, augmented the effect of the powder, I likewise made trials as to the correctness of this notion, using sawdust from fresh cut, from dry, and from green woods, and even moistening a pound of it with one-twelfth of its volume of clear water, and although the operation of filling and lighting was performed with the utmost possible dispatch, yet I noticed no augmentation in the effect produced. But even supposing this to be really the case, how many difficulties stand in the way of this method, since it would be exceedingly difficult, if not impossible, to fix the exact proportion of moisture. It is by no means an easy matter to induce the workmen to act up to instructions, which his confined views prevent him from fully comprehending; and, indeed, the aversion to innovation is so great, that after the lapse of three years, I still find old miners who will rather purchase their own powder for blasting than use the mixture.—*Karsten's Archiv.*, vol. v. p. 199. 1822.

Experiments for ascertaining the difference of consumption in using powder alone, or a mixture of equal parts of powder and sawdust, were continued for eight months, in the year 1818, and the results were the following, four months being employed for using each, under similar conditions:—It appears, first, that the total saving of powder was fully one-third; second, that in the four months during which the mixture was used, although five more men on the average were employed daily, yet only 25 cwt. 37 lbs. were required, instead of 30 cwt. 23 lbs., Silesian measure, leaving a balance in favour of the mixture of nearly 5 cwt.; and, thirdly, that in these months more labour was comparatively performed.

Similar experiments were also made at Dortmund, in Westphalia, and were attended with a satisfactory result. It was found that six pounds of mixed powder were equal to eight pounds unmixed per fathom. It was even found by experiments conducted above ground, that a charge of half powder and half sawdust, well mixed, produced the same effect as powder alone in the sandstone. Counter trials were made of charges as above, and others with the half charge of powder alone, from which it appeared, that although each charge contained the same quantity of powder, yet those without the sawdust were almost entirely without effect. The sawdust from beech and poplar had the same power as that of fir; and it appeared that iron and copper filings answer the same purpose, which proves that the favourable effect produced can be ascribed as little to the looseness of the material mixed with the powder, as to a chemical dissolution of the sawdust; nor can the evolution of gases in the mixture be the cause of it.

The most powerful mixture was proved to consist, not of granulated powder, but of simple powder of purified saltpetre, flower of sulphur, and purified charcoal in the same proportions as the French fowling powder, mixed with beech sawdust. Experiments have been successfully made in other mining districts, as Essen-Werden and the Mark; and measures are being adopted in the mining districts of Westphalia to ascertain with accuracy the exact saving which can be effected.—*Zeitschrift der Mineralogie*, 1829, p. 400.

ON THE APPEARANCE OF ROCK SALT ON THE COAST OF CHILI.

The "Annales Maritimes" notices the fact, that on the coast of Chili, south of Coquimbo, a crust of rock salt is found, extending 140 miles in length and several miles in width, having the appearance of the compact ice which forms on the surface of lakes and rivers in America. The thickness of the salt is about two feet, and as soon as a portion of it is removed, its place is again supplied by fresh salt. For a considerable distance the main road skirts along the side of this singular formation; and it is found that the carcasses of animals lying upon it are preserved a long time from putrefaction.—*Ibid.*

GLASGOW MALLEABLE IRON WORKS.

[From the *Dumfries Courier*.]

Iron, of all metals, is the most important and valuable, when we consider the innumerable uses to which it may be turned. The buccaneers, when they plied their hateful avocation, and were honest enough to patronise the principle of barter, commanded every necessary on the strength of this article alone; the untutored Indians, with stores of hidden wealth under their feet, knew not how to barb their arrows properly without the aid of such foreigners as accident or the love of adventure threw in their way; and although they almost every where have made prodigious advances since Mr. Locke penned the following passage in his well-known "Essay on the Human Understanding," it is still unfortunately too applicable to the more benighted portions of the globe:—"Whatever we think of our arts or improvements in this part of the world, where knowledge and plenty seem to vie with each other, were the use of iron lost among us, we should, in a few ages, be unavoidably reduced to the wants and ignorance of the ancient savage Americans; so that he who first made use of that apparently contemptible mineral, may be truly syled the father of arts and author of plenty."

These remarks may be pronounced strikingly just; and comparing times past with times present—the infancy of art with its growing maturity—we almost regret that so sagacious an observer did not survive to witness some of the wonders of the present century: such as three hundred furnaces in full operation, iron bridges swung across arms of the sea, boats built of the same material, locomotives rivalling the eagle's flight, and America, in place of an endless forest, a congeries of railroads, canals, turnpikes, harbours, cities, towns, and crowded marts of every description. In the absence of iron, the steam-engine and spinning-jenny, not to speak of many other inventions, would have been things in abeyance to the end of time—inventions, which fought and gained the battles of Europe, and are still equally useful in upholding the general peace of Europe, by conferring on a mere speck of the ocean, a species of supremacy which is felt in the remotest quarters of the globe. Steel is simply carbonized iron; and but for both of these metals, where would be the commercial dignity of such places as Birmingham and Sheffield, the money circulated, the bread given to tens of thousands, the large sums drawn from foreign countries, which help to keep the exchanges even, and above all, the prodigious additions made to the culinary and domestic comforts of almost every nation in the civilized world? Simond, the French-American traveller, who visited Birmingham more than a quarter of a century ago (March, 1811), and of course weened little of its present condition, whether as regards population or the improvements of machinery, gives the following vivid picture of what fell under his own observation:—"In one place 500 persons were employed in making plated ware of all sorts, toys and trinkets. We saw there patent carriage steps, flying down and folding up of themselves as the door opens or shuts, chairs in walking-sticks, pocket umbrellas, extraordinary cheese-toasters, and a multitude of other curious inventions. In another place, three hundred men produce ten thousand gun-barrels in a month; we saw a part of the process; enormous hammers wielded by a steam-engine of the power of 120 horses, crushed in an instant red hot iron bars, and converted them into thin ribbons. In that state they are wrapped round a rod of iron, which determines the calibre. Bars of iron for different purposes, several inches in thickness, presented to the sharp jaws of gigantic scissors, moved also by the steam-engine, are clipped like paper. Iron wire, from an inch to the tenth of an inch, is spun out with as little effort, and less noise, than cotton thread on the jennies. Large millstones, employed to polish metals, turn with so great a velocity as to fly sometimes to pieces by the mere centrifugal force. Streams of melted lead are poured into moulds of all sorts; and copper is spread into sheets for sheathing vessels, moved also by the steam-engine, like paste under the stick of the pastry-cook."

In 1740, the quantity of pig iron manufactured in England and Wales, the united product of fifty furnaces, merely amounted to 17,000 tons, or less than a fortieth part of the returns given for the year 1827, when the furnaces in Staffordshire, Shropshire, Wales, Yorkshire, Derbyshire, and Scotland, had increased to 284, and their product as near as may be to 700,000 tons of pig iron. A very great increase has taken place in the iron trade during the nine years that have elapsed since that period. The demand for railroads has given a fillip to the manufacture, altogether unprecedented in its previous history. One company in the west of Scotland is talked of as having cleared, by the advance in the price of iron last year, 60,000*l.*, and in all probability still larger fortunes were made in Staffordshire and South Wales—counties which produce more of the mineral in question, than all the other parts of Britain put together.

Until very lately, if we except a small work at Muirkirk (lately enlarged), the art of making malleable iron was little known in Scotland. The whole mass of wrought or bar iron, necessary for the promotion of the useful arts in Scotland, was imported from Staffordshire and South Wales; certainly a strange state of things, considering the natural capabilities of the country. To produce the base of all the irons, and their highest result steel, three things are necessary—the ore itself, lime, and coal; and where, it may be asked, is the country, its size considered, in which minerals, leading to kindred results, are more obtainable, exhaustless, and abundant?* In transferring manufactures from one part of the country to another, the difficulty often consists in constraining the initiated to become voluntary exiles from the land of their birth; but this difficulty the proprietors of the Glasgow Malleable Iron Works have fairly overcome, by the importation of as near as may be 300 brawny workmen from Staffordshire and Wales. A beginning in this way has at length been made, and we have the authority of a most intelligent merchant for saying, that malleable iron works, whatever the scale may be, before the lapse of many years, will be established in almost every part of Scotland. Coal and lime are nearly universal, and the existence of these, apart from all other considerations, will lead to a diligent, and, we doubt not, a successful search for ironstone, so soon as our countrymen become thoroughly familiarized with the practice of an art which, in some of its departments, is positively sublime.

On entering the Glasgow iron-works, our first feelings were those of surprise, not unmingled with a lurking sense or suspicion of danger. A high pressure steam-engine, in connection with the uses to which it is applied, affords a beautiful exemplification of the power of art in the wars she wages with inert matter; the removal of the solid mountains themselves seems almost within the range of its illimitable powers; the force exerted is oppressively tremendous—the motion concentrated, rapidity itself; the mechanician's, like the magician's wand, seems to have called fiends into existence it is unable to lay. Ample supplies of pig iron, coal, and char, are received by the Glasgow Iron Company by means of the canal, which is situated immediately behind their works. The first process is that of refining, and, with a view to this, ore, such as is used by the founders, is put into the finery along with a due proportion of charcoal, and melted by means of a powerful blast. The roaring of the bellows is heard at a considerable distance, and the metal, when thoroughly boiled or melted, remains in the liquid state an hour and a half; it is then run into a cast-iron mould, and cooled as rapidly as possible, and receives, when this operation is finished, the name of refined metal. At this stage it is broken small, weighed into charges, and thrown into the puddling furnaces, where the conversion takes place from the state of cast to that of malleable iron. In these furnaces it is kept in a state of constant agitation for an hour and a quarter; two men attend each, and ply their iron *spurtles* so assiduously, to prevent what a cottage cook would call "knots," that, but for the glow the interior presents, one might almost suppose them engaged in making porridge on a very large scale. There is a Scottish proverb to the effect that "it needs a lang-shanked spoon to sup wi' the deil," and the spurtles we speak of are so long and ponderous, that to wield them for half an hour with proper effect, requires bone and muscle of the first order. At one part of the process, the heat is so great that the puddlers are compelled to cast aside their garments, and remain naked from the middle upwards; and such is the virtue that resides in puddling, that, but for the constant stirring, the fiery mass would, on removal, remain in much the same state it entered the furnace. The exact nature of the change which produces conversion is a secret unknown to the chemists themselves; but it seems clear that something is inhaled or evolved, which extracts from the iron its former brittleness, and imparts to it its future malleability. When the puddling has ceased, the metal in the furnace is rolled into balls, and in that state conveyed to the squeezers or hammers, by the operation of which it is rolled and cut into certain lengths for the convenience of the trade, and piled into heaps, from which it can at any time be withdrawn, under the name of puddle bar-iron.

The next stage in the process of the manufacture of malleable iron, is the heating furnace, where supplies from the piles just spoken of, are brought to welding heat, tossed upon the floor near the rolling-mill, lifted by a brawny man, who is armed with an enormous pair of tongs; presented to the widest partition in the rollers; received by another strong workman on the opposite side; lifted and passed through the second opening; received as before; and, in short, zigzagged through every aperture of the ponderous rollers, "small by degrees, and beautifully less," until the article is elongated into bars of iron of every varying length and thickness; or, in other words, such as we frequently see laid down at the warehouse doors of every furnishing ironmonger in the country. While the rolling process is in progress, a person, who stands beside the workmen, guages as they proceed, to preserve uniformity; and, this duty discharged, the bar is stamped with the company's seal, pared on the edges by enormous shears, straightened where the slightest bend appears, and consigned to the heap of finished goods, ready to be thrown on the general market. There is something highly imposing in the operations of the rolling-mill, and the truly muscular workmen who supply the hissing grist that feeds it. The lumps of burning metal presented to its acceptance are frequently of the weight of fifty, sixty, and seventy pounds; and though a little extra assistance is occasionally given, the masses spoken of are for the most part lifted lever-wise—that is, by pincers—by a single individual; in passing the bars through the different compartments of the mill, not a single moment is lost, and but for the rests that occur at short intervals, and the beer that is imbibed to promote perspiration, it would be impossible to prosecute so exhausting an employment for the space of ten hours per day. When on the spot, we were lucky enough to see the great cauldron opened which contained the molten pig-lead; and no man who has witnessed such a scene—however dissimilar or disproportionate the scale—can be at any loss to conceive the effects of a volcano.

So long as the complement of men at these works averages from two hundred and sixty to three hundred, the manager calculates that he will be able to produce fifteen tons of finished iron per week, including bars, bolt-rods, boiler-plate, angle-iron, sloops, railway-bars, railway carriage-wheel tyre, colliery tram-plates, &c. &c. As the wages of the workmen vary from 1*l.* to 3*l.* 10*s.* per week, this head of expense of itself amounts to a round sum per annum, to say nothing of the raw material, fuel, charcoal, and various other items; and we suppose we do not exaggerate when we say that the capital embarked in the undertaking is not under 100,000*l.* sterling. Two high-pressure engines impel the machinery, and wield between them the power of two hundred and thirty horses.

* In 1824, out of 700,000 tons of iron made in Great Britain, only 55,000 were made in Scotland. The quantity made in Scotland in 1835 was 75,000 tons, being an increase of 19,000 tons in eleven years. It is probable that the quantity made at present (February, 1837) is nearly double what was made in 1824.

IRON WORKS IN FRANCE.

At a late meeting of the Statistical Society, Mr. Porter stated, that Englishmen may well consider it a reproach to the nation collectively, that our best-founded suspicions as to the correctness of our statistical data concerning the production of coal and iron, the most important by far of our mineral treasures, are derived from the researches of a French gentleman, who, in the course of a recent tour through the three kingdoms, has visited every iron-work, and with very few exceptions, every coal-field, in England, Scotland, and Ireland; and has ascertained on the spot, and within the smallest possible limits, the capability and actual working of each individual establishment: and it may be stated, that the estimates of production hitherto formed in regard to both coal and iron have been ascertained by Mons. Le Play, the foreigner alluded to, to be very far below the truth. The fact, that a foreign gentleman, known to be the agent of a foreign government, has been able, through the frank and liberal kindness of the coal-owners and iron-masters throughout the United Kingdom, to obtain satisfactory answers to his inquiries, is highly honourable to our countrymen, and may be offered as some set off against those feelings of mortification, which we cannot but experience, at the necessity which compelled him to make a long and toilsome journey in search of information, which ought to have been accessible to him without leaving his own country. It is well known that the French Government has established a board of commissioners, under the control of the Minister of the Interior; the duties of which are pretty well defined under the title of "Direction Générale des Ports et Chaussées, et des Mines." This board has under its orders a competent staff of well-educated engineers, part of whose duty it is to collect the statistical details of the works they are appointed to inspect. A report, in which these details are embodied, has very recently been made, in which the amount and value of the industry of each department of France during the year 1834, are given with a degree of minuteness and of accuracy, that cannot fail to be satisfactory and practically useful. The following is a very brief extract of the results brought forward in the report of the commissioners. The subject is divided under six heads—viz. iron-works; fuel; metals, other than iron; salt, alum, and copperas (sulphate of iron); quarries; and lastly, various operations connected with mineral substances. The iron-works of France are spread over a great part of the kingdom, there being only twelve out of the eighty-six departments into which France is divided, where iron-works are not carried on. The quantity of ore extracted from the whole of the iron-mines in France, in 1834, amounted to 15,750,990 metrical quintals, equal to 1,551,473 tons English weight, and the value 3,606,308 fr., or 144,252*l.* The number of smelting furnaces in use is stated to have been 374, and the weight of iron produced 221,886 tons. About five-sixths of this quantity was made in the form of pig-iron, and the remainder into castings of various kinds. The value added to the material by these operations, was 32,437,551 fr., or 1,297,502*l.*—*Literary Gazette.*

MR. CROSSE'S EXPERIMENTS.

At the meeting of the Ashmolean Society (Oxford), on the 6th ult. Dr. Buckland informed the meeting that he had received a letter from Mr. Crosse, detailing the results of a new series of experiments, by which he has succeeded in obtaining 100 more animals of the same description as those obtained by previous experiments. On a piece of volcanic slag, connected with the electric wires at both ends, a fluid, containing silex and muriatic acid, was gently dropped. The animals, soon after their formation, were washed off from the slag, and deposited in a wooden funnel underneath. Without muriatic acid the same animals were formed; but when no electricity was used, the animals did not appear. The animals have been exhibited at the Royal Institution, by Mr. Farady, whence originated the erroneous report that Mr. Farady had, by a series of similar experiments, produced the same animals. The animals were at first supposed to be infusoria, similar to those discovered by the microscopic observations of Ehrenberg; but, on being shown to naturalists in London, they are discovered to be of a much higher order, very closely resembling the well-known acari which infest cabinets, with the exception that they have no hairs. It was, however, suggested by Dr. Buckland, that the hairs most probably had adhered to the gum used to stick them on the card, or had been rubbed off by friction during their carriage to London.

Mr. Crosse, in a letter to a daily paper, says, "With respect to those experiments of mine in which insects made their unexpected appearance, I have given no opinion whatever as to the cause of their production, having, as I at first stated, mentioned 'facts, but not opinions.' Without more data than we at present possess, I do not see how it is possible to form an opinion on the matter, or to say whether the electric agency is or is not the secondary cause or accelerator of their birth. Since my two first experiments I have met with eight other results in which similar insects have appeared: in the whole ten separate formations. Five of these have been in silicious solutions, and five in other fluids, one of them a concentrated solution of nitrate of copper. In all of these the electrical action was long continued before the insect made its appearance; but this might have been the case otherwise. In the course of my observations I have met with some rather curious phenomena, which shall be laid before the public when the train of experiments now in hand, and which must necessarily occupy some time, is completed."

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The Mining Journal

AND COMMERCIAL GAZETTE.

SUPPLEMENT—XV.

REVIEWS.

Transactions of the Institution of Civil Engineers. Vol. I. Weale, London. 1836.

The volume before us possesses claims to no ordinary attention, both from the great value of the matter which it contains, and as being the first work of the kind which has emanated from the "Institution of Civil Engineers"—a body chiefly composed of men whose knowledge and labours are at this moment effecting the most important changes in the aspect and condition of society. Could a higher value be attached to this work than that which it must command from the number of the articles contained, from the importance of the subjects, and the talent and acknowledged merits of the authors, it might be derived from the slowness, the care and caution with which it has been matured, before being presented to the world. The "Institution of Civil Engineers" has now been in existence almost twenty years—nearly half of that period as an incorporated body—yet it is not till the present time that its labours have been made public. During this long period a mine of information on all subjects connected with the profession of the Civil Engineer has been accumulating in each succeeding session, from the united labours of the Institution, and from this mine the most valuable products are now extracted, and condensed into the volume before us.

The work commences with an admirably-written introduction, in which the progress of Civil Engineering in this country is briefly reviewed, and a short notice is given of the labours of those eminent men, whose names adorn this profession, and who have left such enduring memorials of their genius in almost every quarter of the British empire. The body of the work is occupied by a selection of articles on various subjects connected with Engineering, which had been previously read at the meetings of the Institution, and from their number and importance, they fully attest both the individual zeal and the combined exertion of the Society from which they emanate. The volume concludes with a copy of the regulations of the Institution, and its charter of Incorporation, together with a considerable number of valuable and well-executed plates, illustrating the various subjects treated of in the work; nor can we omit to name another highly appropriate embellishment—the portrait of the late distinguished President, Telford—under whose fostering care the Institution of Civil Engineers rose from comparative obscurity to its present eminence, and has been made the source of widely-extended and national utility.

The history of every civilized nation, from periods of the most remote antiquity, affords numerous examples of the construction of works of grandeur and utility, of which, after the lapse of centuries, many still remain—proud and enduring monuments of the skill and power of nations, which, in the great revolutions of empires, have since fallen to decay, and in many cases ceased to exist. The pyramids of Egypt still raise their massive forms over the desert plain, on which they were raised in the infancy of art and of society, by one of the earliest nations of whose existence we have any trace or record—the massive ruins of Balbec still fix the admiration of the eastern traveller, and the lofty columns of "Tadmor in the wilderness," still raise their giant heads amidst surrounding desolation, in the beautiful fancy of the poet—

———"flinging their shadows from on high,
Like dials, that the wizard Time
Had raised to count his ages by."

And forming the proud and sole trophy of the grandeur and magnificence of the greatest of the Israelitish monarchs.

But among all the nations of antiquity, the Romans stand pre-eminent for the number and greatness of their public works, which still rise in melancholy grandeur in the streets of the "eternal city." Independently of the architectural works which were produced by the Romans, in common with their contemporaries, this extraordinary people cultivated to a great extent those undertakings which may be considered as more particularly falling within the province of the engineer. These works they rendered subservient to their ruling passion, the love of conquest and dominion, and their great military roads, their noble bridges, and magnificent aqueducts, may still be traced even in parts of Europe most remote from their seat of empire, and not a few remains of their military constructions even now exist in our own country. The more limited empire of the Greeks, and their natural advantages of soil and climate, were less favourable to the production of grand and massive works; but by this nation architecture was cultivated with the greatest success, and their ruined temples still remain the most approved models of elegance and refined taste.

The rude aborigines of our own country, unskilled in art, and too disunited for combined exertion, do not appear to have attempted any works remarkable either for their magnitude or utility, excepting some few devoted to the services of religion. The massive circle of Stonehenge, and other Druidical temples which still remain, are sufficient, however, to show some traces of the spirit and ingenuity which in more civilized nations, and under more favourable circumstances, have produced the grand and magnificent results before alluded to.

During the middle ages, when throughout Europe the monks were the chief depositaries of knowledge, and working on the fears and superstitions of mankind, possessed themselves of unbounded wealth and power also, few great works were undertaken for public utility or convenience, although the splendid ecclesiastical edifices which were then erected, prove not only a high degree of taste as regards architectural design, but considerable skill in the art of construction also. Although the monks naturally devoted their chief attention to the erection of ecclesiastical edifices, and have concentrated the greatest efforts of their genius on the venerable and magnificent cathedrals and abbeys, which still form the principal ornaments of the ancient cities of Europe, their labours at times embraced the wider range of civil and military architecture. Windsor Castle was built by William of Wykeham, Bishop of Winchester; and the old London Bridge, Rochester Bridge, and many similar works were, we believe, planned and directed by ecclesiastics.

This brief and hasty glance at some of the earlier efforts of mankind, to apply the physical resources they possessed to works of grandeur and utility, leads us to the comparatively modern period when such efforts have been made, not only more frequently and on a larger scale, but with greater system and effect—the result of more extended knowledge, and of widely altered moral and political circumstances. The causes producing these results were slow in operation, and it is almost within our own times that their effects have been fully developed—so fully as to require the entire devotion of talent and of labour to this especial object. The desultory nature of some of the first engineering efforts in this country are well pointed out in the introductory portion of the work before us; it is true, that either at home or abroad men were always found capable of executing any works of magnitude that were required, but when the great end in view was achieved, their talents no longer found permanent employment, except by foreign engagements. Thus Westminster Bridge, the first extensive undertaking of the kind in modern times in this country, was built by M. Labelye, a native of Switzerland; and our countryman Perry, who successfully accomplished the great work of repairing extensive breaches in the embankment of the Thames at Dagenham, in Essex, found afterwards in Russia continued employment for those talents, to which England at that time afforded only a casual and occasional demand. It is indeed little more than half a century since the profession of engineer has existed distinct from that of architect; and Mylne (the builder of Blackfriar's Bridge) was one of the last examples of these professions being combined in the same individual.

The introductory pages of the volume before us, as already noticed, briefly but ably trace the progress of British Engineering, glancing at the respective works and merits of those distinguished men, whose talents have been devoted to this profession—a class including a Smeaton, a Rennie, and a Telford—the latter almost the father of the Institution, under whose auspices it is published. From this introduction we shall chiefly make our extracts on the present occasion, leaving the more technical portion of the volume for a future notice.

Some of the earlier attempts at great engineering projects in this and other countries are thus decribed:—

"Though operations of engineering, in common with all the useful arts, are practised by men in the rudest state, and become of greater and more frequent application as society improves, it is only among a people very considerably advanced in civilization and wealth that its works can be prosecuted on an extensive scale, or with any degree of success. The only exceptions to this observation are to be found during the few and short periods in the history of the world, when it has fallen to the lot of nations to be governed by such men as Louis XIV., guided by the wisdom of Colbert and having the aid of Riquet's enterprise and Andréossy's skill; some of the kings of Sweden, who, turning their troops into excavators of canals, have in person directed their labour; Peter the Great, Frederick of Prussia, and in our own day, Mehemet Ali; princes who, whether from a singular appreciation of the true means of greatness, or with a view to facilitating their warlike measures, or as it may be in some cases, prompted by mere love of the glory to be gained, have forced works of public utility before their time in the countries under their sway. The great Languedoc canal; often repeated attempts to open a communication between the North and Baltic seas, independent of the passage through the Sound or the Belt; an inland navigation from the Neva to the Volga, the junction of the Elbe with the Oder and Vistula, and the railway now forming from Cairo to Suez, are among the peaceful trophies of these monarchs. But such desultory efforts, even when most successful, as in the foregoing instances, stand like oases in the otherwise desert field of improvement, refreshing to meet with, but no sign of fertility in the surrounding waste; and proceeding from power in the ruler rather than will in his subjects, their effects are not of that permanent and expansive character which belongs to the voluntary undertakings of a free community.

"Of such undertakings it may probably be said, without any imputation of national vanity, England offers the most splendid examples, though even among us they are of recent growth. During a long period of our history, men's minds were either wholly turned away from pursuits of this kind, or at best, their activity in them was paralysed by the excitement and uncertainty that could not but prevail when a throne was the object of struggle, and the shock of the contests so engendered was too deeply felt by the industry of the country to be recovered from in the short intervals that sometimes happened between the outbreakings of intestine war. But better times came round;—domestic quiet was established, and as the passions that had raged so fiercely gradually subsided, the people's energies no longer spending themselves in civil strife, took another and more useful direction, and the genius of commercial enterprise was called into new life.

"The passing of the Act of Parliament for the formation of the Sankey-Brook navigation (the earliest *canal* in England) in 1755, was the beginning of a new era in the annals of internal improvement. Works of engineering, it is true, had previously been executed, some of them of considerable magnitude. Rivers had been deepened and rendered navigable, the metropolis was already supplied with water by the completion of Sir Hugh Myddleton's scheme of the New River, fens had been drained and embankments made to protect them from the inroads of the sea;—some of these works belong to our early history. More recently, the means of at least military communication had been extended to the most remote parts of the kingdom, by the roads formed through the north of England into the Highlands of Scotland under the direction of General Wade, and M. Labelye had led the way in bridge-building on a large scale and with new methods by the construction of Westminster bridge, which was begun in 1739; while, about the same time, under the unassuming character of a country mason, William Edwards had, in the bridge of Pont-y-Pridd over the river Taaf,* set an example of intrepidity and determination that has never been surpassed. But all these undertakings, important though they certainly were, must, when viewed in connection with what has been effected since, be considered rather as the results of detached efforts, arising generally from the necessities of the individual case, and too often involving the injury or even ruin of their promoters, than as the offspring of an enlarged spirit of improvement, stimulated by the hope of gain from investment, and a well-founded prospect of its undisturbed enjoyment.

"Many facts may be cited in proof of the distinction here made. The very name of *adventurers* formerly given to those who undertook such hazardous enterprises evinces the feeling with which they were generally regarded, and they were of so unusual occurrence as not to furnish sufficient employment to support in the country a race of artists trained to works of the kind. If an Englishman followed such avocations, he had, from lack of work enough at home, to look for it abroad, as in the case of Perry, who so distinguished himself by the stoppage of the alarming breach in the Thames embankment at Dagenham in the beginning of last century, but who had had in his best days to seek in the then infant Russia the constant occupation Britain could not at that time afford him; while, on the other hand, in the drainage of the Great Fens, and many other like instances, it was necessary, in the dearth of natives competent to the duties, to bring men of skill from other countries to direct the operations, as the occasion required. By such means, however, the way was no doubt paved for the marked change that now took place in the system of public works; the mineral productions of the country became every day more necessary for its manufacturing processes, extending on every side; capitalists began to embark their wealth in speculations that promised a pecuniary return only, without regard to their own neighbourhood being the scene of the projected improvement, or facilities being afforded by it to their peculiar business. The change was a type of increased national means, and by the enlarged field of employment it opened up, gave rise to a new order of professional men."

The writer then proceeds to give a short historical review of our earlier engineers, and from this highly interesting notice, we are induced to make the following copious extract, commencing with Brindley and Smeaton, the two earliest names in the profession, and probably for the greatness and utility of their works surpassed by none:—

"Born of humble parentage in an obscure village of Derbyshire, and obliged by his situation in life to devote himself to the labours of agriculture from his earliest youth almost unto manhood, Brindley* was altogether without education, in the common meaning of the word, a want which the unceasing duties of his active life never gave an opportunity of supplying, even if the inclination existed. Guided by natural bias, he afterwards became a millwright, and in this capacity soon acquired by his mechanical skill a high provincial celebrity. This, however, great though it was, might not have survived him long, or extended far beyond his immediate district, but for the fortunate occurrence which, when he had reached the age of forty, gave a new developement to his genius, and turned his pursuits into a stream destined to bear his name to future ages, in proud union with one whose high rank is eclipsed by the benefits his enterprise and liberality bestowed on his country. This incident in Brindley's history was his being called by the Duke of Bridgewater to advise on his project of a canal from Worsley to Manchester. The result of the application requires not to be stated;—leaving the beaten track behind, Brindley, strong in his own powers, struck away at once into a new path, and sustained by the unflinching support of his generous patron, placed inland navigation, by one gigantic stride, so far in advance of the age, that even in the present day the works of that time may almost afford to dispense with their date, as an element in the appreciation of their merit.

"Brindley's reputation was now achieved; his practice as an engineer henceforth increased steadily, and though almost wholly confined to the construction of canals, few of his profession, however, varied their avocations, can boast works of equal extent or importance. Besides the Bridgewater canals, with their many miles of under-ground communications in the Worsley coal mines, their then unprecedented aqueduct of Barton, and an extent of level surface even now unparalleled; the Grand Trunk navigation, boldly penetrating through the great central ridge of England by the Harecastle tunnel, the Staffordshire and Worcestershire, the Coventry, the Oxford, the old Birmingham, and the Chesterfield canals, were all designed, and with one exception executed by Brindley;—and thus, though he had watched over the cradle of inland navigation, a communication by means of it was established by his labours between places so distant and divided by natural barriers as London, Liverpool, Bristol, and Hull; while, by his success, the far more important object of awakening public attention to the advantages of canals was also fully attained.

"Smeaton's† happier lot exempted him from the struggle with adverse circumstances in early life, which his great contemporary had to encounter. Springing from the middle ranks, he had the advantage of a fair education, and, save the sacrifice of a short time to legal studies, in compliance with a parent's wish, fortunately there was nothing to thwart the bent of his genius, which soon showed itself decidedly. Established in the metropolis as a philosophical instrument-maker, he gained the notice of the scientific world by his ingenuity, and by several communications to the Royal Society on mechanical subjects, and so high had he raised himself in estimation, even when engaged in such pursuits, that though untried and unknown as a practical engineer, he was selected as the fittest person to be entrusted with the rebuilding of the Eddystone lighthouse when it was destroyed by fire. This, Smeaton's first work, was also his greatest;—probably, the time and all things considered, it was the most arduous undertaking that has fallen to any engineer, and none was ever more successfully executed,—and now, having been buffetted by the storms of nearly eighty years, the Eddystone stands unmoved as the rock it is built on, a proud monument to its great author. Buildings of the same kind have been executed since, but it should always be borne in mind who taught the first great lesson, and recorded the progressive steps of his work with a modesty and simplicity that may well be held up as models for similar writings. His reports are entitled to equal praise,—they are a mine of wealth for the sound principles they unfold, and the able practice they exemplify, both alike based on close observation of the operations of nature, and affording many fine examples of cautious sagacity in applying the instructions she gives to the means within the reach of art.

"Strange though it may now seem, Smeaton's rise in the profession for which he had so signally proved his qualifications, was not at first rapid, but amid the rage of public works that then grew up, the man who had built the Eddystone lighthouse could not be long passed by, and once fairly launched in general practice, he soon became connected more or less with almost all the great improvements then in progress, contributing largely to the advancement of engineering in every branch. The bridges of Coldstream, Perth and Banff, the Forth and Clyde ship canal, the Aire and Calder, the Fosdyke, and other navigations and drainages in the fens as well as elsewhere, and the harbours of Rye, Ramsgate (the grand pattern of artificial harbours) and Portpatrick, with important though not so extensive operations in many other ports, rank among his leading works, but give no idea of the extent and variety of a business altogether without equal in that day, and rarely surpassed since; for besides being as it were the great *standing counsel* of his profession, to whose judgment all doubtful questions were submitted, he was constantly employed in carrying his own measures into effect, and his execution was attended with such success that, on the occasion of the solitary failure by which it was marred, we find him lamenting it can no longer be said, that 'in the course of thirty years' practice, and engaged in some of the most difficult enterprises, not one of Smeaton's works had failed!' But his genius and resources were not wanting to him even in Hexham bridge;—it was in the operations designed to avert the dreaded catastrophe, when the foundations of that structure began to give way, that the diving-bell was first brought into the service of the engineer.

"Such were the fathers of British engineering. Among their worthy associates were Grundy, who, in addition to many works of navigation and drainage, particularly in the fens of Lincolnshire and in Yorkshire, introduced docks in the Humber by the construction of the Old dock at Hull;—Henshall, Brindley's brother-in law and fellow-labourer in most of his undertakings;—Semple, who built Essex bridge over the Liffey in Dublin;—Mylne,‡ for many years engineer to the New River Company, who began his professional life as the architect of Blackfriars bridge in London, and was also the original engineer of the Eau Brink cut and the Gloucester and Berkeley canal;—Golborne, an authority in his day in the treatment of rivers, of his success in which the Clyde is a favourable specimen; and Whitworth, engineer of several important canals, of which the Thames and Severn may be named as one, and who has the merit of having designed and executed the Kelvin aqueduct on the Forth and Clyde canal, a great work at that time:—all these names deserve honourable mention, though in this brief retrospect a passing notice only can be bestowed on them.

"William Jessop§ claims to be more particularly alluded to. This excellent man held an intermediate place in time between what may be considered

* This remarkable bridge is 140 feet span with a rise of 35 feet, and being only 11 feet wide, has a singularly bold appearance,—stretching like a rainbow across the romantic glen below.

* Born at Thornsett near Chapel-en-le-Frith, in 1716—died in 1772.

† Born at Austhorpe near Leeds, in 1724—died in 1792.

‡ Born in Edinburgh, in 1734—died in 1811.—Robert Mylne may be looked on as the last practitioner of note, who combined in a considerable degree the avocations of the engineer and the architect. The professions have since become almost entirely disjoined, but the study of architecture ought still to form a branch of the engineer's early discipline, for though utility and strength are no doubt the main objects of his practice, the works are few that may not be benefited by the application of taste, without sacrificing those essential characteristics.

§ Born at Plymouth in 1745—died in 1814.

the first and second generations of civil engineers, and he was the first of his profession that can be said to have been regularly bred to it. The pupil, and afterwards for several years the confidential assistant of Smeaton, he was reared in the best school, and it is not paying any niggardly tribute to his abilities and character, to say, that his subsequent career shed no discredit on his great master. His extensive practice consisted chiefly, though by no means exclusively, in works connected with navigation and drainage. The magnitude of his labours in these is attested by the improvements on the rivers Aire and Calder and the Trent during the time he held the appointments of engineer to those undertakings, by many of the numerous navigations intersecting the midland counties, by the great work of the Grand Junction canal connecting the central districts of England with the metropolis, by the inland navigations of Ireland on which he was the principal adviser, and by the City ship canal across the Isle of Dogs;—while in the Surrey iron *rail* or rather *tramway*, which, though not successful as a speculation, deserves notice as one of the earliest applications of this mode of conveyance to the purposes of public traffic, and in the conversion of the part of the river Avon through the city of Bristol into an immense floating dock, with the bridges and other structures accessory to it, he appears equally at home in other walks. These are the principal works which were more directly Jessop's;—he was besides consulting engineer of the West India Dock company in London, and of the Ellesmere Canal Company, and indeed from standing at the head of his profession for several years after the retirement of Smeaton, he was called in on most of the great schemes then in agitation, and also engaged in their execution, but they will be mentioned in connection with the men more immediately concerned in them, and to whom they are more usually ascribed, if not in a greater degree due. Any other course would evidently be quite out of place in a paper of the nature of the present, the object of which can with propriety only be to indicate generally the works on which different engineers have been employed, not to pronounce on the individual share in them falling to each.

"The second race of engineers now began to take their part more conspicuously on the stage. By the exertions of their predecessors, Britain had already gained a high reputation for her public works;—the support of the national fame in this respect was now to pass into other and younger hands, among whom Rennie and Telford were early distinguished. A wide field of labour lay before them. Works which had been begun but a very few years before were now yielding their profits, in many instances to the individuals who had originally embarked in them, and their success allured others to like adventures;—the operation of this cause alone would have much enlarged the bounds of professional employment,—the public relations of the country extended the opportunity further. What had been done hitherto was chiefly the result of private enterprise;—this great moving force was still left free to act, and indeed was strengthed by men in authority more than before, while another power of only inferior intensity was superadded to it:—works of unparalleled magnitude were now undertaken by Government, both for the internal improvement of the country and as contributory means to its external defence, and in such works some of the engineer's proudest triumphs are to be found.

"John Rennie* occupied a foremost place in maturing and executing these mighty projects, public and private, and his previous training had admirably qualified him for the duties they required. He displayed almost in childhood the mechanical bias that marked his future character, and whether as the apprentice of the ingenious Meikle, the inventor of the threshing machine, or as an occasional student under some of the most celebrated of the men by whose labours the university of Edinburgh acquired fame throughout Europe, all his subsequent pursuits tended in the direction that was to lead him to eminence. He began business as a millwright in his native county, but was soon after led to change the scene of his busy life, in consequence of an introduction to James Watt,† who invited him to the capital to superintend the erection of the Albion flour mills, by which and other works in the same line, undertaken on his own account in quick succession, he soon acquired reputation as a very superior mechanist, and in the year 1791 or 2, he was appointed to direct the execution of the Lancaster canal. This and the Crinan ship canal (insulating the isthmus of Cantire in Argyleshire) with which he was entrusted about the same time, were his first essays in civil engineering, and by the greatness and difficulty of some of their works (as the fine aqueduct over the river Lune in the former, and the massive rock excavation of the latter), they afforded an excellent opportunity of testing his skill.

"Rennie soon became firmly established,—the government of the land afterwards ranked among his clients,—the three kingdoms bear witness to the extent of his subsequent labours. The navigations already mentioned, to which the Kennet and Avon and the Portsmouth canals fall to be added; the completion of the Eau Brink cut, and the project of the new Nene outfall for the improvement of drainage in the immense fens of Norfolk, Lincoln, and Cambridgeshire; a participation in a greater or less degree in the formation of three of the large dock establishments in the port of London, with Leith docks, and extensive additions to those of Liverpool and Hull, for commercial purposes; the still more stupendous undertakings in aid of war at his Majesty's dock yards, especially Sheerness, raised by him out of a quicksand five-and-twenty feet deep and ten feet under low water, and Pembroke, which he hardly lived to see completed; the breakwater in Plymouth Sound, the artificial harbours of Kingstown, Howth, Holyhead, and Donaghadee, and two great bridges over the Thames, in the heart of the metropolis, with the design for a still nobler third, built since his death, and other bridges in the country, of which that over the Tweed, at Kelso, and Wellington-bridge in Leeds, particularly challenge notice; all these were wholly, or in chief part, produced by Rennie, and they by no means exhaust the list of his works, of which the variety, magnitude, and importance need not be expatiated on after such an enumeration.

"The name of Rennie naturally suggests that of his compeer, Telford, though in the few short years that elapsed between their deaths, the grave also closed over more than one other that cannot be passed unnoticed even in the most cursory review of this kind.

"In the person of Thomas Telford‡ another striking instance is added to those on record of men who have, by the force of natural talent, unaided save by uprightness and persevering industry, raised themselves from the low estate in which they were born, to take their stand among the master spirits of their age. A native of the pastoral district of Eskdale, he received the education commonly given to the peasantry of that country, and was at an early age apprenticed to a stone-mason in the neighbouring village of Langholm, with whom he remained until his twenty-third year. The New Town of Edinburgh was then in progress, and thither Telford bent his steps, led probably by the prospect of employment in the works of that improvement. Returning to his native border at the end of two years, he found there too bare and narrow a sphere of action for his already aspiring mind, for while plying his trade he had not neglected to cultivate his understanding, and he now felt conscious of powers fitting him for a higher destiny. He came to London, where after working for a time as a mason in the quadrangle of Somerset House, then building, his superior intelligence attracted notice, and he was appointed to superintend the erection of a new official residence in Portsmouth dock-yard, which occupied him until 1787. He then, on the invitation of Sir William Pulteney, himself a borderer,§ undertook the direction of some alterations in Shrewsbury Castle, and was soon after elected county surveyor of Salop, a situation he held to the day of his death. In this official capacity bridge-building chiefly claimed attention,—a short time added another important branch to his avocations:—in 1793 he was nominated acting engineer of the Ellesmere canal, and thus was Telford fully introduced to the practice of a profession he was in a few years to take so distinguished a lead in. The road to fame was now open before him, and he never lost sight of the goal.

"There is hardly a corner of Great Britain that does not contain some record of Telford;—his services were required by the Crown, and foreign powers also availed themselves of his skill, at least in one memorable instance, the great ship canal of Gota in Sweden, the last connecting link in the navigation from the Baltic sea to the German ocean through the Swedish lakes. The Caledonian canal (originally proposed, along with the Crinan canal, by Watt to the Commissioners of Forfeited Estates, and also advised on by Jessop, though its execution was under Telford's charge) is a work of similar character in our own country, and with it may be named the Gloucester and Berkeley canal, before mentioned in connexion with Mylne, which, though not of equal magnitude or difficulty, is also adapted for sea-borne vessels of large tonnage, and has made the inland city of Gloucester a port for foreign trade; while the Ellesmere canal, already alluded to, with its bold aqueducts of Chirk and Pontcysylte, in which also he was associated with Jessop, the Shrewsbury canal, the Birmingham and Liverpool Junction canal, with extensive improvements of the old Birmingham canal, and also of the navigations through the district of the Fens, are among the other important additions made by Telford to internal water communication. The improvements of the river Clyde to an extent little contemplated in the days of Golborne, the numerous harbours for fisheries in the northern coasts of Scotland, Aberdeen and Ardrossan harbours, the harbour and docks of Dundee, Saint Katharine's docks in London, the Glasgow waterworks, several bridges over the Severn, especially those of Tewkesbury and Over at Gloucester, Broomielaw bridge over the Clyde, and Dean bridge in Edinburgh, swell the catalogue of only his principal undertakings. But the works which will perhaps appear of most moment to a mind looking at the consequences to civilization, are the great systems of roads,—the Highland, the Holyhead, and the Glasgow and Carlisle, by which, but especially the first mentioned, whole regions were brought as it were within the pale of society; while their thousands of bridges, including among them such structures as those of the Menai and the Conway, Dunkeld, Craig-Ellachie and Cartland-Craigs, with the enormous cuttings in the sea-cliffs of North Wales, attest their greatness in an engineering point of view.

"The foregoing sketch, though slight, may enable some judgment to be formed of the services rendered to their country by Telford and Rennie respectively. In looking back upon their professional achievements, it is pleasing also to reflect on the high respect with which they were regarded in their lifetime,—both employed by the king's Government in its various departments, alike enjoying the almost unlimited confidence of the public for a long series of years, and in going down to the grave, meeting with equal honour:—while Rennie's remains lie 'tombed beneath' the magnificent canopy of Saint Paul's Cathedral, Telford's 'ashes found their latest home' within the venerable walls of Westminster Abbey."

* Born at Phantassie in Haddingtonshire, in 1761—died in 1821.

† Born at Greenock, in 1736—died in 1819.—In early life Watt himself practised as a surveyor and engineer, and had he continued in the profession, would in all probability have taken the lead;—a more glorious immortality awaited him, but no one has contributed more essentially to the progress of engineering than that illustrious man, from the facilities, before unknown, given by his steam-engine to its operations.

‡ Born at Westerkirk in Dumfriesshire, in 1757—died in 1834.

§ Of the family of Johnstone of Westerhall.

The remaining portion of the introduction is chiefly occupied in tracing the origin and progress of the "Institution of Civil Engineers;" which, commencing with the private meetings of a small number of gentlemen connected with the profession, has now attained the rank of a highly useful and respectable incorporated body. As our space will not allow of the lengthened notice required by the volume before us, we shall here conclude, proposing shortly to return to it again.

Analysis of Railways; consisting of a series of Reports on the twelve hundred miles of projected Railways, in England and Wales, now before Parliament, together with those which have been abandoned for the present Session, &c. &c. By FRANCIS WHISHAW, Esq., Civil Engineer, M. Inst. C. E. Weale, London. 1837.

[Second notice.]

On returning to Mr. Whishaw's "Analysis of Railways," we may remark that the general plan and merits of the work were fully described in our former review, but we shall now introduce some portions of it to the notice of our readers which, from limited space, we were before prevented from doing.

The following summary conveys some important information respecting the aggregate works, which will be required to carry the whole of the projected lines of railway into execution:—

"The number of proposed railways, including diversions, extensions, and branches, in England and Wales, for which plans have been lodged in the Private Bill Office in the present session, is seventy-five, of which only forty-eight are under the consideration of Parliament; these amount in length to twelve hundred and thirty-three miles, and are estimated at the sum of nineteen millions three hundred and fifty-two thousand seven hundred and twenty-six pounds,* or fifteen thousand six hundred and ninety-five pounds per mile. The whole length of tunnelling is twenty-five miles; and the number of bridges, exclusive of viaducts and culverts, two thousand eight hundred and twenty-five, or nearly two and a third per mile. The weight of iron required for the rails, is one hundred and ninety-three thousand five hundred tons; and of stone for the blocks, two millions six hundred and seventy thousand tons. The area of land required to be taken, is upwards of fifteen thousand acres; and of felt for the chairs, one hundred and thirty acres. These railways, if carried into execution, would employ at least five thousand men and fifteen hundred horses for three years.† The principal competing lines are the five Brighton, the two Birkenhead and Chester, and the South Union, and Manchester Cheshire and Staffordshire Railways.

"The proposed railways in England and Wales, abandoned in the present session, are twenty-seven in number, amounting in length to seven hundred and ninety-four miles; the length of tunnelling is about eight and three-quarter miles; and the number of bridges one thousand five hundred and ninety five, or about two per mile."

Mr. Whishaw has appended a very useful glossary to his work, explaining all the most usual technicalities made use of by engineers with regard to railways. As this glossary is calculated to be of much service, by removing *mystification* from a subject in which the public is so deeply interested, we shall make two or three extracts from it. The term "locomotive engine" is thus explained:—

"LOCOMOTIVE ENGINE.—Locomotive engines of very imperfect construction were in use for a long time previously to their introduction on public railways. The Stockton and Darlington Railway is the first on which this master-piece of human skill was introduced as a substitute for horse-power. Many of the engines still used on this line are very ponderous and clumsy, but still they are powerful. The Lord Brougham may be quoted as an example; it is an engine sixteen feet in length, supported on six heavy wheels, each three being connected together by cranks; these wheels are each four feet in diameter, the whole weight is about twelve tons. The two cylinders are placed in front of the chimney, and are each fourteen inches in diameter, the piston of each working vertically, and communicating with the cranks beneath, attached to the wheels.

"On the Manchester and Liverpool Railway, the proportion of the number of engines in daily use, is almost one to every three miles, and about as many more under repair: among those at present in use may be mentioned, the Collier, the Mercury, the Rapid, the Hercules, the Ajax, the Speedwell, and the Thunderer. Some of these engines were built by Messrs. Taylor and Co., of the Vulcan Foundry, near Warrington.

"On the Dublin and Kingstown Railway, where the passenger-traffic is very considerable, the trains starting from either end of the line, almost twenty times a day, the number of engines is nine; they are severally called the Manchester, the Britannia, the Vauxhall, the Kingstown, the Dublin, the Comet, the Vittoria, and the Stanley. Three of these were built by Messrs. Sharp and Roberts, of Manchester, and have eleven-inch cylinders, and sixteen-inch stroke; and the remainder by Mr. Forrester, of the Vauxhall Foundry: the weight of these engines is from about nine to ten tons; many of them are of elegant design.

"On the Leicester and Swannington Railway, where the tonnage of coal alone, from Mr. Stephenson's and other collieries, is about 500 tons a-day, the number of engines is seven, viz. the Comet, the Hercules, the Goliah, the Vulcan, the Atlas, the Samson, and the Liverpool.

"The Atlas and Vulcan, each with six wheels, are two of the most powerful engines at present in use, on any line of railway, having cylinders of sixteen inches diameter, and twenty-inch stroke; they are built for heavy loads and slow speeds.

"The Hercules, Goliah, and Samson, have each fourteen-inch cylinders, and eighteen-inch stroke; and, lastly, the Comet and Liverpool, twelve-inch cylinders, and fourteen-inch stroke.

"The valuable work on locomotive engines by the Chev. de Pambour, contains the best possible information with regard to the construction of the locomotive engine."

Mr. Whishaw thus describes the "oblique arch," better known perhaps as the "*skew arch*," which is now so frequently used in crossing roads, rivers, canals, &c., which must necessarily be often traversed very obliquely by railways:—

"OBLIQUE ARCH,—Or, as it is commonly called, the skew arch, is rendered necessary in a line of railway, where it is not desirable to alter the course of the canal, road, or river to be crossed. The construction of oblique arches requires very great skill, both on the part of the engineer, in drawing out the proper developement of the several parts, and the mason, in carrying the design into effect.

"On the Manchester and Liverpool Railway, the arch carrying the London road over the railway, near Rainhill, is of this description; its span is fifty-four feet on the skew, and the angle of obliquity thirty-four degrees.

"In the Greenwich Railway Viaduct, there are twenty-seven skew arches; the most worthy of notice is that over Bermondsey-street."

The subject of railway tunnels has been much discussed of late.

* This sum is exclusive of four of the proposed Brighton lines, one of the Southern lines from Manchester, one of the Birkenhead and Chester lines, the Great Western, Southampton, North Midland, and Eastern Counties' Diversions; and also the line from Gillingham to Exeter.

† For the earthworks alone.

Mr. Whishaw furnishes the following information with regard to them:—

"TUNNELS.—Tunnelling is the art of constructing subterraneous passages, by means either of perforating the earth, through horizontal shafts on the side of a hill, or by sinking vertical shafts after the manner of a well; the latter is the most frequent method. In the present state of railway operations, very few lines can be carried through a great extent of country without resorting to this tedious and expensive method.

"The tunnels on the Manchester and Liverpool Railway are three in number; the first, ascending from the Wapping Station to Edgehill, is 2200 yards in length, twenty-two feet wide, and sixteen feet high; the side walls are perpendicular for five feet in height, supporting a semicircular arch of brick, but some portions of the roof are formed through the natural rock. This tunnel was executed by means of vertical shafts. The small passenger tunnel, descending from Edgehill to the original station in Crown-street, is 290 yards in length, fifteen feet wide, and twelve feet high.

"The new tunnel, descending to the station in Lime-street, is about one mile in length, twenty-five feet in width, and nineteen feet in height; at the western entrance, the arch is segmental, and rises twelve feet six inches.

"On the Birmingham Railway there are several tunnels, amounting in length to little more than three and a half miles.* The principal are those of Primrose Hill, Kensall Green, Watford, Weedon, Kilsby and Birkswell.

"The Primrose Hill tunnel is 1250 yards in length, twenty-two feet high, and twenty-two feet wide. The vertical shafts, which are left open for ventilation, are five in number, and are of about nine feet clear diameter. The brickwork is eighteen inches, or one and a half bricks in thickness, and built for the most part in cement; the stratum passed through is the plastic clay of London. At the top of each of these shafts, a horse gin was set up, and kept in operation, for the purpose of lowering the bricks and other materials, and raising the clay excavated.

"The Watford Tunnel is carried through chalk, which Mr. R. Stephenson, the engineer, describes as of a jointy nature, and mixed with flints, and that great difficulties have presented themselves in its execution.

"The whole length is one mile thirty-nine yards. In executing it, vertical shafts, similar to those of Primrose Hill Tunnel, are used: about the middle, two large shafts, for the purpose of ventilation, are left open: together, forty-five feet in length by thirty-two feet in width. The sides are segments of circles; the wall between them is three feet in thickness, at the middle.

"A great deal of the chalk excavated is carried to spoil. The tunnel or archway at Kensall Green is about a quarter of a mile in length, and was executed by excavating the ground, and shoring up the sides during the operation of building.

"The Kilsby Tunnel, about 2200 yards in length, has proved to be the most difficult to execute, on account of the strata passed through being to a certain extent a running sand, which is one of the most troublesome enemies to tunnel operations.

"Tunnels originally proposed in the London and Birmingham Railway:—

1.	Primrose Hill		44·50
2.	Hatch End		14·75
3.	Watford	1	1·50
4.	Near Tring		16·
5.	Leighton Buzzard		16·
6. 7. 8.	Three near Weedon		62·
9.	Kilsby	1	23·
10.	Berkswell		20·
		4	37·75

"On the first plane of the Canterbury and Whitstable Railway, ascending from Canterbury, the tunnel is half a mile in length, twelve feet wide, and twelve feet high. On the Newcastle and Carlisle Railway, which is about sixty miles in length, there is but one very short tunnel. On the Leeds and Selby Railway, which is a great passenger railway, there is one tunnel, towards the Leeds end, 2100 feet in length, seventeen feet in height, and twenty two feet in width, on an inclination of 1 in 210.

"The ventilating shafts are three in number.

"On the Whitby and Pickering Railway, there is a small tunnel, about 130 yards in length, ten feet wide, and fourteen feet in extreme height. The side walls are vertical for nine feet, and support an eighteen-inch arch of brickwork. The design of the entrances is in the castellated style of architecture, and forms a striking feature amid the romantic scenery of the Eske.

"The tunnel on the Leicester and Swannington Railway, is about 1760 yards, or a mile in length, ten feet eight inches in width, at surface of rails, and eleven feet five inches, at springers of semicircular arch, which, as well as the whole structure, is of brick, eighteen inches, or two bricks, in thickness; the total height is thirteen feet six inches. There are four large vertical shafts, which were used for carrying on the works, about five feet in diameter in the clear; and eight ventilating shafts, eight feet high above ground, and three feet diameter in the clear.

"The passage through this tunnel is rendered very disagreeable by the use of coal for the engines; but it is to be observed, that this line is not especially designed for passengers, the chief traffic being in coals, and granite from the Groby Quarries; nevertheless, there are frequently seventy passengers a-day passing along some part or other of the line.

"The usual speed in passing through this tunnel is at the rate of about fourteen miles an hour; the plane is level; the brickwork of the tunnel is two and a half bricks in thickness."

We may, in conclusion, repeat our conviction of the great value of Mr. Whishaw's work, more especially to engineers and professional men engaged in any of the various departments of railway communication. We hope its reception by the public may induce him to enter, as we before suggested, upon a work of a similar kind on those lines which are either completed or in progress, with free remarks on all that may require comment, either as regards their merits or defects.

An Appeal to the Public on the subject of Railways. By GEORGE GODWIN, Jun., Associate of the Institute of British Architects. Weale, London. 1837.

Mr. Godwin's pamphlet is intended to prove—what, we apprehend, few reasonable persons will be disposed to deny—the great public advantages which must arise from railway communications; and on this subject his arguments, although certainly possessing no claims to novelty, must, we conceive, be held perfectly conclusive. To adduce elaborate arguments in proof of a self-evident proposition, would be indeed a work of supererogation, were it not that prejudice is obstinate and deep-rooted, and will only give way to strong and often repeated attacks. Prejudice and error have ever been opposed to the advance of improvement, and although unable to arrest its progress, have often seriously impeded its results; the present work may, therefore, not be without its use, as exposing the erroneous principles on which railway communication has been opposed by weak, though perhaps, in some cases, well-meaning persons. The line of argument pursued is very similar to that adopted in an admirable little work, published a few years ago, entitled the "Results of Machinery," and generally attributed to the pen of Lord Brougham, although, we believe, chiefly written by Mr. Knight. In this work, the advantages of machinery generally are ably and lucidly described; and we need only observe, that Mr. Godwin has successfully followed a very similar plan with regard to those attendant on railways.

The Railway Magazine, and Annals of Science. No. XIV. New Series. April, 1837. Wyld, Charing-cross.

The present number of the "Railway Magazine" contains, like the former ones, some useful articles on the scientific branches of the subject, but its pages are chiefly occupied this month by railway reports, of which there is an unusual influx. These will be read with interest, as showing, in an authentic form, the present condition of the several companies, and the progress made towards accomplishing the objects they have in view.

* Mr. R. Stephenson's evidence on the Brighton Railway, Session 1836.

We are sorry, however, to perceive a great want of courtesy in some of the Editorial remarks on the Reports of Medical Men respecting the atmosphere of tunnels; we do not question either the pith or the justice of many of these observations, but should much prefer to see them couched in terms less personal and offensive than those which are made use of in the present number of this work. The first report of "the commissioners appointed to inquire into the manner in which railway communications can be most advantageously promoted in Ireland," is a valuable and interesting document, and well deserving of public attention.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. VIII.

EXPLOSION OF FIRE-DAMP IN A LEAD MINE.

NOVEL INSTANCE OF AN EXPLOSION OF FIRE-DAMP IN A LEAD AND SILVER MINE, IN THE HARZ, WITH A DESCRIPTION OF ITS REMARKABLE ORIGIN BY THE WORKS BEING DRIVEN INTO THE ANCIENT LEVELS OF THE HANSBRANNSCHWEIGER MINE.

[*Communicated by* Dr. Zimmermann, *Secretary of the Mines at Clausthal.*]

Inflammable air, although often met with in coal mines, is of rare occurence in other mines. In the Harz but few instances have been known of such gas becoming ignited; never, indeed, unless when the levels had been driven so as to re-open old mines. This has, however, occurred on two occasions in the Harz. The first is noticed by Hönemann in his "Antiquities of the Harz," published at Clausthal, in 1755, as having taken place in the mine at that place, in 1661, under circumstances similar to those which distinguished the recent explosion which we are about to describe.

Hönemann says, "In the year 1661, the following incident took place in the mine of St. Anne, at Clausthal, which had for some years previously been filled with water, and had consequently been abandoned. As two night-workers were descending the shaft of St. John, they were met at the depth of about sixty fathoms, by a powerful current of air proceeding from the mine of St. Anne, which took fire from the lights they were carrying, their hair and skin were severely singed, and they escaped with difficulty up the ladder, almost the whole shaft being in a blaze. For several days the mine continued to burn, with an unpleasant smell, so that no one could enter it, until at length, when the noxious damp had become exhausted, it was found that a level had been driven too near the St. Anne mine, from which there proceeded a sudden irruption of water and confined sulphurous air, the one inundating the mine, and the other taking fire, from the workmen's lights."

In reference to the above narration, it may here be observed, that it is improbable that the mine continued several days on fire, since the inflammable gas burns away rapidly, and is then replaced by atmospheric air.

The second instance on record, took place at the St. Andreasberg mine, in the Harz; the details of which are given by the mining director, Von Trebra, in his "Experiences in the Interior of Mines," published at Leipsic, 1785. He observes, "About the end of the year, 1778, an entrance was made from the St. Andreasberg mine, into the old workings of the Beerberg. The water, at first, rushed forth with violence, afterwards flowing with moderate rapidity, when noxious vapours were observable, a communication was opened in that part of the workings for the purpose of ventilation. The superintendents and miners proceeded at different times in the direction of the breach, to make observations, but always returned immediately on finding that the foul air began to extinguish their candles, whilst they experienced a difficulty of breathing, and observed a disagreeable odour. On the 12th of January, 1779, two superintendents boldly ventured to explore the level, in order to discover how far the damp had cleared off beyond the air adit, which they closed behind them, but they had scarcely proceeded twenty fathoms, when their lights began to burn dimly with a bluish flame, and finally went out, as they were beginning to return, at the same instant, that the whole air around them burst into a flame. Their jackets seemed all on fire, although it was afterwards found, that they were only burnt in holes. One of the men was burnt in the foot, the other in the hands, by endeavouring to extinguish his jacket. The door of the air adit was shattered, and splinters of it carried four fathoms from the spot. The unprotected parts of the men, as their hands and faces, were scorched, and their hair and eyebrows singed."

The case of a similar nature, which occurred recently in the Hansbrannschweiger mine, was more accurately observed than the two former; and is a proof that the Harz miner, while exposed to so many other casualties, is not exempt altogether from the danger of fire-damp; a description of these cases may therefore be useful, by pointing out precautionary measures against an evil, which when accurately known, may be the more easily guarded against. We shall, however, first give some account of the mine itself, and of the circumstances under which the explosion took place.

The Silbernaaler lode, whose direction is towards the valley of Clausthal, where it reaches the surface, passes under the Frankenschar Foundry, traverses part of the Einersberg, and in its progress through the Schelberg and Banersberg approaches the bed of the river Innerst. Through the last-mentioned mountain it dips westward as far as the neighbourhood of the Bergstagt, and is met with farther eastward, near the Lower Clausthal, in the levels driven from the Rosenhöfer mine. There is no doubt that it continues its course farther in an easterly direction, southward of the town of Clausthal. From this extent of several German miles,* it is evident, that this lode is one of the principal ones in the Harz, the more so as the width is very considerable, being on the whole fifteen fathoms. Next to lead-glance containing a large proportion of silver, heavy spar is a material part of its substance, this mineral not being found in such abundance in any other part of the Harz, nor probably in any other situation. Notwithstanding the vast extent and width of this lode, it has hitherto been worked, in the proper acceptation of the term, only in the space between the Frankenschar iron works and the Banersberg, that is to say, it is only in this space that mining on an extensive scale has been conducted upon it.

On this lode are situated the ancient workings, as well as the present productive mine of Bergwerkswohlfahrt, the former are those carried on in the sixteenth century. As early as the year 1578 the Nicholas mine was noted for its productiveness; and the principal mine of Altes Hansbrannschweig, from which the whole set derives its name, gave considerable produce in the first half of the seventeenth century. From 1680 to 1686 the works were renewed with vigour in this mine, the bottom of which was at that time filled with water; and in a short time from the commencement, a return of produce was obtained. This mine alone, as far as we know, has been worked beneath the lowest part of the George level, and its main shaft had been sunk 167 fathoms, when, in the year 1733, in consequence of unfavourable circumstances, as want of water, choke damp and defective management, this mine was abandoned, and with it the whole set; it had previously been renounced in 1719, in consequence of the rising of the water. Since then the deepest workings, extending, it is said, sixty fathoms in length, and rich in ore, have not been worked; the utmost depth at which the works were continued, till 1733, was a few fathoms below the present lowest levels of the works. With so deep a level as the George, the intersection of the Silbernaal mine could not be avoided: but, with a prudent foresight, the direction of the latter was so managed as to afford some security against coming unexpectedly upon the old workings; yet, notwithstanding this, water was tapped between the second and third air adits, which greatly impeded the work, by the violence of its irruption. The observations of a mining officer, on this remarkable case, will probably be communicated to the public at a future opportunity.

The completion of the deep George level rendered it possible to enter the Silbernaal lode from thence; and accordingly, at the depth of eighty fathoms, a cut was made northward towards it. Here there was a certainty of finding a fresh field, and of avoiding the old works, although the Luneberg mines are situated higher, and extend as far as the Frankenschar iron works. The above lode was entered, and shortly afterwards the mining officers were so fortunate as to reach the mass of ore about 100 fathoms in length, in which the Bergwerkswohlfahrt mine has now excellent workings, both above the George level and also thirty fathoms beneath it. This mine has not yet a separate shaft, an air adit being deepened for the purpose.

As the old works were now in front of the operators, the labours could not be continued without hazarding an irruption, for which reason it became desirable to tap off the water in the old mines, since any attempt to raise it to the surface would have been impracticable. It was therefore resolved to bore from a level previously made, at a great depth on the west, until it might be calculated that the old works were closely approached. The cut or level alluded to is 148 fathoms in length, having four crosscuts to the more recent works of the last-mentioned mine, and accordingly the object was successfully accomplished, although not without great danger and some injury to the four intrepid and deserving individuals, whose escape we shall shortly have to describe. The boring had been continued for twenty-two fathoms, and the augur finally passed through a fathom of heavy spar and other veinstones; then through a layer of clay, a chasm or vacuity of eight inches in width; a little water was then found, and the augur afterwards passed through a solid mass of greywacke, as it proved in the lode itself, and it was supposed that the work might be continued without apprehension, in the hope of meeting with a shaft in the wall of the lode. It was not possible, however, to form a correct judgment of the relative position of the old mines from a total want of plans and sections of them.

[*To be concluded in our next.*]

* One German mile is equal to about four and two-thirds English.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—March 22.

Rev. W. Whewell, President, in the chair.

A paper "On the supposed ancient state of the North American Continent, especially on the extent of an inland sea, by which a great portion of its surface is conjectured to have been covered; and on the evidences of progressive drainage of the waters," by Mr. Roy, was commenced.

On April 5th, Mr. Greenough, V.P., in the chair.

The reading of Mr. Roy's paper was concluded.

The author of this communication having been employed in extensive surveys, especially in the lake districts of North America, found, on drawing out sections for professional purposes, that the country everywhere exhibited successive ridges which encircled the lakes; and, upon comparing sections to the north of Lake Ontario with others to the south, that the ridges exactly corresponded in elevation. The highest of these ridges is 996 feet above the level of the sea, or 762 above that of Lake Ontario, and connecting this elevation with the physical features of the great valleys of the Mississippi, and the Missouri, Mr. Roy supposes, that the whole of the area, bounded on the west by the Rocky Mountains, from the table land of Mexico, to the parallel of forty-seven degrees of latitude—on the north, by the barrier separating the head waters of the lakes from those of the northern rivers, and extending to Cape Tourmante, below Quebec—and on the east by the hills stretching through the United States, to the Gulf of Mexico—formed one vast inland sea, occupying 960,000 square miles.

Having thus given the extreme height and supposed extent of the sea, the memoir proceeded to show, by what progressive operations the author considers, that the boundaries were broken through, and the waters drained off, till they were reduced to the detached basins, forming the Canadian lakes. These details, however, cannot be understood without the aid of diagrams.

A paper "On the Geology of the neighbourhood of Smyrna," by Mr. H. E. Strickland, F.G.S., was then read.

The vicinity of Smyrna consists of limestone, and greenish slates, containing Hippurites, lacustrine limestone, and marls, and trachytic rocks.

The Hippurite limestone and schist form considerable tracts, both to the north and south of the bay of Smyrna, constituting Mount Sipylus, Mount Tartali, and Mount Corax. In some localities it consists of grey limestone, more or less associated with black and greenish schists, but in others it is composed almost solely of the latter. The lacustrine deposits constitute an extensive table land, ranging south from Smyrna, and to the north of the bay—the southern base of Mount Sipylus. Mr. Strickland is of opinion that they were accumulated in a basin, bounded principally by the hills of hippurite limestone. The table land is composed chiefly of white or yellowish limestone, sometimes resembling chalk, at others the compact, secondary limestone of the Ionian Islands, and contains nodules and layers of black flint, with quartz resinite. White and greenish marls are interstratified with the limestone and extensive beds of gravel, especially towards the margin of the basin. The beds are generally horizontal, but in some places, when near the trachyte, they are inclined. The shells found by the author belonged entirely to freshwater genera, but in the deposit at the foot of Mount Sipylus he discovered a rich store of vegetable remains, in the highest state of preservation, and consisting of leaves of about twelve species, which belonged to the genera Laurus, Nerium, Olea, Salix, Quercus, and Tamarix.—*Trachyte.* This volcanic rock Mr. Strickland ascertained to be more recent than the lacustrine deposits, because in the plain of Pedikeui, it overlies the freshwater limestone; and because no pebbles of it occur in the alternating beds of gravel. The trachyte is principally porphyritic and homogeneous; but it sometimes contains numerous angular blocks and fragments of black porphyritic trachyte, much harder than the general body of the rock; and near the ford of the Meles it contains a mass of quartzose conglomerate. In some localities the trachyte splits into slabs, from a foot to an inch thick, and the cross fracture exhibits stripes of various colours, parallel to the planes of cleavage. These layers are occasionally accumulated to the thickness of 100 feet, and are traceable laterally for as many yards.

The paper concluded with some general observations on the changes produced in the features of the country by the eruption of the trachyte, and the drainage of the lake in which the lacustrine formations were deposited.

A letter from Mr. R. W. Fox, of Falmouth, to Sir Charles Lemon, Bart., was afterwards read.

The object of this letter was to prove, that though the non-mechanical deposits in mineral veins may be due, in part, to infiltration from the inclosing rocks, yet that they might have been derived in almost indefinite quantities from currents of heated water, ascending from the deeply-seated portions of the original fissures. Water in this condition, Mr. Fox says, would be highly capable of holding in solution earthy or metallic substances, and, in ascending, would gradually cool, and deposit against the sides of the fissures its mineral contents.

He is of opinion that the formation of mineral veins cannot be due to simple chemical affinity only, because the accumulation of the metallic masses is not found, in Cornwall at least, to depend on the nature of the containing rock, the ore of a given metal being sometimes found in granite or in elvan, and not in killas; and sometimes in the latter, and not in either of the former. On the contrary, he considers that the remarkable concentration of ores in some rocks, in preference to others, may have resulted from their relative positions; but that electricity has been the most active and powerful agent in determining the distribution of the contents of veins.

Extracts from two letters on the earthquake in Syria, in January last, addressed by Mr. Moore, his Majesty's Consul-General at Beyrout, to Viscount Palmerston, and communicated by J. Backhouse, Esq., and the Hon. W. T. H. Fox Strangways, Under Secretaries of State.

The first letter, dated Beyrout, Jan. 2, 1837, announces that the earthquake was felt in that city at thirty-five minutes past four o'clock in the afternoon of the preceding day. It was accompanied by a rumbling noise, lasted about ten seconds, and appeared to proceed from the north. No buildings were thrown down in the town, but seven or eight without the walls, and one or two lives lost. In the neighbourhood of Beyrout the course of the river Ontilias was suspended, and mills, built on its banks, were deprived of water for some hours. When the stream returned, it was turbid, and of a reddish sandy colour.

During the day of the earthquake the atmosphere was close, and charged with electricity. Fahrenheit's thermometer stood at sixty-six degrees, but five minutes after the earthquake it rose to seventy degrees. Four or five minutes after the shock the compass was still agitated. The oldest inhabitants did not remember so severe an earthquake.

The second letter was written also at Beyrout, partly on the 9th of January, and partly on the 23rd. It contains detailed accounts of the damage which has been done to numerous towns and villages. At Damascus, four minarets and several houses were thrown down; and at Acre, part of the walls and some buildings. Saffet was entirely destroyed, and nearly all the population, amounting to between 4000 and 5000 had perished. The ground near the city was rent into fearful chasms, and up to the last accounts shocks were felt daily. Tiberiad was also entirely overthrown, except the baths, and the lake rose and swept away many of the inhabitants. The dispatch contains a list of thirty-nine villages which had been totally destroyed, and six partially; and Mr. Moore says, it had been ascertained that the earthquake was felt on a line of five hundred miles in length by ninety in breadth. It was also perceived in the island of Cyprus.

ADDRESS TO THE GEOLOGICAL SOCIETY,

DELIVERED AT THE ANNIVERSARY, BY CHARLES LYELL, JUN., ESQ., PRESIDENT.

[*Concluded from page 55.*]

A cavern has lately been examined at Yealm-bridge, six miles south-east from Plymouth, by one of our members, Lieut.-Colonel Mudge, R.E., from whose account it appears that the bones of hyænas are very numerous there. They are associated with those of the elephant, rhinoceros, horse, and other animals usually found in caves. The number of fossil Carnivora, such as the hyæna, wolf, fox, and bear, which have now been met with in districts of cavernous limestone in Great Britain, is so great that we are the more struck with the rarity and general absence of such remains in surrounding and intervening districts, over which the same beasts of prey must have ranged. The Pachydermata, as the elephant, rhinoceros, and hippopotamus, are often discovered in ancient alluvial or fluviatile deposits; but had there been no caves and fissures we should scarcely have obtained any information respecting the existence of lions, tigers, hyænas, and other beasts of prey which inhabited the country at the same period.

The remains of at least two distinct Saurian animals have been discovered by Dr. Riley and Mr. Samuel Stutchbury, in the dolomitic conglomerate of Durdham Down, near Bristol. They are allied to the Iguana and Monitor, but the teeth, vertebræ, and other bones, exhibit characters by which they are seen to be generically distinct from all existing reptiles. They are particularly deserving of your attention, as occurring in the bottom of the magnesian limestone formation, the oldest strata in which the bones of reptiles have as yet been found in Great Britain. The most ancient examples of fossil reptiles known on the continent of Europe occur also in the zechstein of Germany, a formation of about the same age.

I alluded last year to a memoir of Sir Philip Egerton's, in which he pointed out some peculiarities in the structure of the cervical vertebræ of the Ichthyosaurus. He has now proved that in all the species of this genus there are three accessory bones, which he proposes to call, from their shape and position, subvertebral wedge bones. They are supplementary to the atlas, axis, and third vertebra of the neck, and seem to have escaped the observation of Cuvier and other osteologists.

Mr. Lewis Hunton has communicated to the Society an elaborate account of a section of the upper lias and marlstone, in Yorkshire, showing that different beds in those formations are characterized by particular species of Ammonites and other Testacea, each species having a limited vertical range. His observations are valuable, not only as illustrating the distribution of fossils on the coast near Whitby, but also as furnishing a point of comparison between that district and many others in Great Britain. Mr. W. C. Williamson, of Manchester, has had the same object in view in studying the fossils of the oolitic formations of the coast of Yorkshire, and informs us, as the result of his patient investigation, that although certain assemblages of fossils abound in particular subdivisions of the oolite, many species range from the lowermost to nearly the highest beds. This inference is confirmed when we compare the lists drawn up by Mr. Williamson, and those published by Professor Phillips and other competent authorities. Thus, some of the shells of the inferior oolite, mentioned in Mr. Williamson's list (*Trigonia Gibbosa*, for example), occur also in the Portland-stone of Wiltshire; another, as *Ostrea Marshii*, is characteristic of the cornbrash, in the same county; others pass downwards to the lias, as *Orbicula reflexa* and *Ammonites striatulus*. If you consult the tables of organic remains, which Dr. Fitton has annexed to his excellent monograph on the strata below the chalk, just published in our Transactions (Second Series, vol. iv. part II.), you will see that a considerable number of shells pass from the upper oolitic groups into the green sand. We are not to conclude, from these facts, that certain sets of fossils may not serve as good chronological tests of geological periods, but we must be cautious not to attach too much importance to particular species, some of which may have a wider, others a more limited vertical range. The phenomena alluded to are strictly analogous to those with which we are familiar in the more modern deposits, where different tertiary formations contain some peculiar testacea, together with others common to older or newer groups, or where shells of species now living in the sea are associated with others that are extinct.

An assemblage of fossil shells has been presented to our museum by Mr. J. Leigh and Mr. J. W. Binney, found at Collyhurst, near Manchester, in red and variegated marls, which were referred by them at first to the upper division of the new red sandstone group; but Professors Sedgwick and Phillips consider them to be a red and variegated deposit, belonging to the magnesian limestone series. As these fossils are new and characteristic of a particular subdivision of the beds between the lias and coal, it is to be hoped that they will soon be described and figured.

The petrifaction of wood, and more especially its silicification, still continues to present obscure problems to the botanist and chemist. The first steps towards their solution will probably be made by carefully examining vegetables in different stages of petrifaction, and with this view Mr. Stokes has procured several specimens of wood, partly mineralised and partly not. Among these is a piece found in an ancient Roman aqueduct in Westphalia, in which some portions are converted into spindle-shaped bodies, consisting of carbonate of lime; while the rest of the wood remains in a comparatively unchanged state. The same author has pointed out cases both of siliceous and calcareous fossils, where the lapidifying process must have commenced at a number of separate points, so as to produce spherical or fusiform petrifactions, independent of each other, in which the woody structure is apparent, while in the intervening spaces the wood has decayed, having, after removal, been replaced by mineral matter. In some petrifactions the most perishable, in others the most durable, portions of plants are preserved, variations which doubtless depend on the time when the mineral matter was supplied. If introduced immediately on the first commencement of decomposition, then the most destructible parts are lapidified, while the more durable do not waste away till afterwards, when the supply has failed, and so never become petrified. The converse of these circumstances gives rise to exactly opposite results. As to the manner in which the minutest pores and fibres discoverable by the microscope, even the spiral vessels themselves can be turned into stone, or have their forms faithfully represented by inorganic matter, no satisfactory explanation has ever yet been offered. In considering, however, this question, you will do well to consult the important suggestion which a celebrated chemist, our late lamented secretary, Dr. Turner, has thrown out on the application of chemistry to geology. He reminds us that whenever the decomposition of an organic body has begun, the elements into which it is resolved are set free in a state peculiarly adapting them to enter into new

chemical combinations. They are in what is technically termed a nascent state, the constituent molecules being probably of extreme smallness and in a fluid or gaseous form, ready to obey the slightest impulse of chemical affinity, so that if the water percolating a stratum be charged with mineral ingredients, and come in contact with elements thus newly set free, a mutual action takes place, and new combinations result, in the course of which solid particles are precipitated so as to occupy the place left vacant by the decomposed organic matter. In a word, all the phenomena attendant on slow putrefaction must be studied whenever we attempt to reason on the conversion of fossil bodies into stone; and, in regard to silicification, Dr. Turner has shown how great a quantity of silex is set free as often as felspar decomposes, and how abundantly siliceous matter may be imparted from this source alone to running water throughout the globe.

As I have mentioned the name of Dr. Turner, I cannot pass on without an expression of sorrow for the untimely death of that amiable and distinguished philosopher. Mr. Whewell and Mr. Murchison alluded in most feeling terms, this morning, at the general meeting, to this melancholy event, which is too recent and too painful to myself and others to allow me now to dwell longer upon it.

Before quitting the subject of vegetable petrifactions, I ought to mention a memoir just published, by Mr. H. R. Göppert, Professor of Botany at Breslau, "On the various Conditions in which Fossil Plants are found, and on the Process of Lapidification."* He has instituted a series of most curious experiments, and his success in producing imitations of fossil petrifactions has been very remarkable. I have only space to allude to one or two examples. He placed recent ferns between soft layers of clay, dried these in the shade, and then slowly and gradually heated them, till they were red hot. The result was the production of so perfect a counterpart of fossil plants, as might have deceived an experienced geologist. According to the different degrees of heat applied, the plants were obtained in a brown or perfectly carbonized condition, and sometimes, but more rarely, they were in a black shining state, adhering closely to the layer of clay. If the red heat was sustained until all the organic matter was burnt up, only an impression of the plant remained.

* Poggendorff, Annalen der Physik und Chemie. vol. xxxviii., part 4. Leipsic, 1836.

The same chemist steeped plants in a moderately strong solution of sulphate of iron, and left them immersed in it for several days, until they were thoroughly soaked in the liquid. They were then dried, and kept heated until they would no longer shrink in volume, and until every trace of organic matter had disappeared. On cooling them, he found that the oxyd formed by this process had taken the form of the plants. Professor Göppert then took fine vertical slices of the Scotch fir, *Pinus Silvestris*, and treated them in the same way; and so well were they preserved, that, after heating, the dotted vessels, so peculiar to this family of plants, were distinctly visible. A variety of other experiments were made by steeping animal and vegetable substances in siliceous, calcareous, and metallic solutions, and all tended to prove that the mineralization of organic bodies can be carried much further in a short time than had been previously supposed.

These experiments seem to open a new field of inquiry, and will, I trust, soon be repeated in this country. In endeavouring, however, to verify them the greatest caution will be required, or we may easily be deceived. We must ascertain, for example, with certainty, that every particle of animal or vegetable matter is driven off before we attempt to determine the full extent to which mineralization may have proceeded. Professor Göppert is doubtless aware, that coniferous wood may be burnt and reduced to charcoal, and, after having been kept for some time at a red heat, will continue to exhibit, on being cooled, the discs or reticulated structure to which he alludes. If, therefore, some small particles of carbon remain in the midst of the oxide of iron, such portions may retain traces of the vessels peculiar to coniferous wood, and an observer, not on his guard, might infer that the same structure was preserved throughout the mass.

In my last address, I alluded to Mr. Lonsdale's detection of vast numbers of microscopic corallines and minute shells in the substance of the white chalk of various counties in England, where this rock had not been suspected of consisting of recognisable organic bodies. I cannot deny myself the pleasure of mentioning the still more singular and unexpected facts brought to light during the last year, by Professor Ehrenberg, of Berlin, respecting the origin of tripoli. I need scarcely remind you, that tripoli is a rock of homogeneous appearance, very fragile, and usually fissile, almost entirely formed of flint, and which was called polir-schiefer, or polishing slate, by Werner, being used in the arts for polishing stones or metals. There have been many speculations in regard to its origin, but it was a favourite theory of some geologists, that it was a siliceous shale, hardened by heat. The celebrated tripoli of Bilin, in Bohemia, consists of siliceous grains, united together without any visible cement, and is so abundant, that one stratum is no less than fourteen feet thick. After a minute examination of this, as well as of the tripoli from Planitz, in Saxony, and another variety from Santa Flora, in Tuscany, and one from the Isle of France, Ehrenberg found that the stone is wholly made up of millions of siliceous cases and skeletons of microscopic animalcules. It is probably known to you, that this distinguished physiologist has devoted many years to the anatomical investigation of the infusoria, and has discovered that their internal structure is often very complicated; that they have a distinct muscular and nervous system, intestines, sexual organs of reproduction, and that some of them are provided with siliceous shells, or cases of pure silex. The forms of these durable shells are very marked and various, but constant in particular genera and species. They are almost inconceivably minute, yet they can be clearly discerned by the aid of a powerful microscope, and the fossil species preserved in tripoli are seen to exhibit in the family Bacillaria and some others the same divisions and transverse lines which characterize the shells of living infusoria.

In the Bohemian schist of Bilin, and in that of Planitz in Saxony, both of them tertiary deposits, the species are freshwater, and are all extinct. The tripoli of Cassel appears to be more modern, and the infusoria in that place, which are also freshwater, are some of them distinctly identical with living species, and others not. In the tripoli brought from the Isle of France, the cases or shells all belong to well-known recent marine species.

The flinty shells of which we are speaking although hard are very fragile, breaking like glass, are therefore admirably adapted when rubbed for wearing down into a fine powder fit for polishing the surface of metals. It is difficult to convey an idea of their extreme minuteness, but I may state that Ehrenberg estimates that in the Bilin tripoli there are 41,000 millions of individuals of the *Gaillonella distans* in every cubic inch of stone. At every stroke therefore of the polishing stone we crush to pieces several thousands if not myriads of perfect fossils.

Gentlemen,—Although I have already extended this Address beyond the usual limits, I cannot conclude without congratulating you on the appearance of Dr. Buckland's "Bridgewater Treatise," a work, in the execution of which, the author has most skilfully combined several distinct objects. He has briefly explained the manner in which the materials of the earth's crust are arranged, and the evidence which that arrangement affords of contrivance, wisdom, and foresight. He has also given us a general view of the principal facts brought to light by the study of organic remains; thus contributing towards the filling up one of the greatest blanks which existed in the literature of our science, while at the same time he has pointed out the bearing of these phenomena on natural theology.

He has shown that geology affords one kind of testimony perfectly distinct from natural history, of the adaptation of particular means and forces to the accomplishment of certain ends for which the habitable globe has been framed. These proofs are illustrated in the author's chapters on the origin and mechanism of springs, on the distribution of metallic and other minerals in the earth, and the position of coal in stratified rocks. In reference to these points it is demonstrated that some even of the most irregular forces have produced highly beneficial results, in modifying the subterranean economy of the globe. But I shall not dwell on this part of the Treatise, but pass on at once to that which constitutes the body of the work, and which relates to palæontology.

In considering this department, the number and variety of objects which offer themselves to the naturalist are so great, that the choice was truly embarrassing. Dr. Buckland has judiciously selected a few of the most striking examples from each of the great classes of organic remains, and when speaking of extinct animals, has explained the method by which the anatomist and physiologist have been able to restore the organization of the entire individual, by reasoning from the evidence afforded by a few bones or other relics preserved in a fossil state. He has described the parts of the living animal or plant most nearly analogous to those which are found buried in the earth, usually illustrating by figures the distinctness and at the same time the resemblance of the recent and extinct species, showing that all are parts of one great scheme, and that the lost species even supply links which are wanting in the existing chain of animal and vegetable creation.

It is impossible to read the account given of the Megatherium, and to contrast it with that drawn up by Cuvier of the same species, without being struck with the increased interest and instruction, and the vast accession of power derived from viewing the whole mechanism of the skeleton in constant relation to the final causes for which the different organs were contrived.

The chapter on saurian and other reptiles has afforded the Professor another beautiful field for exemplifying the infinite variety of mechanical contrivances and combinations of form and structure which the fossil representatives of that class exhibit.

The account also of the Cephalopodous Mollusca, so many thousands of which are scattered through the strata, and which until very recently have presented so obscure a problem to the naturalist, is full of original observation. The history of the animals which formed the Belemnites, of which it appears that nearly 100 species are now known, and the proofs adduced that they were provided with ink-bags like the cuttle-fish, the description also of the fossil pen-and-ink fish, or loligo, and other sections of this part of the Treatise, carry our information respecting the family of naked cephalopods, much further than was ever attempted in any previous work. Nor should I omit to mention the exposition of an ingenious theory for the use of the siphuncle and air-chambers of the Ammonite, which, whether confirmed by future examination or not, becomes, in the author's hands, the means of conveying to the reader a clear and well-defined notion of the varied forms, and complicated structure of these shells, and of awakening a lively desire to understand their singular organization.

I may also recall to your notice the just and striking manner in which certain physical inferences are drawn from the conformation of the eyes of extinct crustacea, such as the trilobite. The most delicate parts of these organs are sometimes found petrified in rocks of high antiquity, and it is justly observed, that such optical instruments give information regarding the condition of the ancient sea and ancient atmosphære, and the relations of both these media to light. The fluid in which these marine animals lived at remote periods, must have been pure and transparent, to allow the passage of light to organs of vision resembling those of living crustaceans; and this train of reasoning naturally leads us still further, and to more important consequences, when we reflect on the general adoption of the undulatory theory of light, and the connection between light, heat, electricity, and magnetism.

I have heard it objected, that the zoologist and botanist had already advanced such abundant proofs of design in the construction of living animals, and plants, that the auxiliary evidence of palæontology was useless, and that to appeal to fossils in support of the same views, was to add weaker to stronger arguments. In the living animal, it is said, we can study its entire organization, observe its habits, see the manner in which it applies each organ, and so verify with certainty, the ends for which any particular member was formed and fashioned. But in the case of the fossil, we have first to infer the greater part of the organization from such parts as alone remain, and then further to infer from analogy, the habits and functions discharged, and lastly the former conditions of existence of the creatures so restored. If then we occasionally fall into error when speculating on the use of the organs of living species, how much more easily may we be deceived in regard to the fossil.

In answering this objection, it cannot be denied that the data supplied by palæontology are less complete; but they are, nevertheless, abundantly sufficient to establish a very close analogy between extinct and recent species, so as to leave no doubt on the mind that the same harmony of parts, and beauty of contrivance, which we admire in the living creature, has equally characterized the organic world at remote periods. If this be granted, it is enough; the geologist can then bring new and original arguments from fossil remains, to bear on that part of natural theology which seeks to extend and exalt our conceptions of the intelligence, power, wisdom, and unity of design manifested in the creation.

It can now be shown that the configuration of the earth's surface has been remodelled again and again; mountain chains have been raised or sunk, valleys have been formed, again filled up, and then re-excavated, sea and land have changed places, yet throughout all these revolutions, and the consequent alterations of local and general climate, animal and vegetable life has been sustained. This appears to have been accomplished without violation of those laws now governing the organic creation, by which limits are assigned to the variability of species. There are no grounds for assuming that species had greater powers of accommodating themselves to new circumstances in ancient periods than now. The succession of living beings was continued by the introduction into the earth, from time to time, of new plants and animals. That each assemblage of new species was admirably adapted for successive states of the globe, may be confidently inferred from the fact of the myriads of fossil remains preserved in strata of all ages. Had it been otherwise, had they been less fitted for each new condition of things as it arose, they would not have increased and multiplied, and endured for indefinite periods of time.

Astronomy had been unable to establish the plurality of habitable worlds throughout space, however favourite a subject of conjecture and speculation; but geology, although it cannot prove that other planets are peopled with appropriate races of living beings, has demonstrated the truth of conclusions scarcely less wonderful, the existence on our own planet of many habitable surfaces, or worlds as they have been called, each distinct in time, and peopled with its peculiar races of aquatic and terrestrial beings.

Thus, as we increase our knowledge of the inexhaustible variety displayed in living nature, and admire the infinite wisdom and power which it displays, our admiration is multiplied by the reflection, that it is only the last of a great series of pre-existing creations of which we cannot estimate the number or limit in past time.

All geologists will agree with Dr. Buckland, that the most perfect unity of plan can be traced in the fossil world throughout all the modifications which it has undergone, and that we can carry back our researches distinctly to times antecedent to the existence of man. We can prove that man had a beginning, and that all the species now contemporary with man, and many others which preceded, had also a beginning; consequently the present state of the organic world has not gone on from all eternity, as some philosophers had maintained.

But when conceding the truth of these propositions, I am prepared to contest another doctrine which the Professor advocates, namely, that by the aid of geological monuments we can trace back the history of our terraqueous system to times anterior to the first creation of organic beings. If it was reasonable that Hutton should in his time call in question the validity of such a doctrine, whether founded on the absence of organic remains, in strata, called primary, or in granite, still more are we bound, after the numerous facts brought to light by modern geology, to regard the opinion as more than questionable. I observe, with pleasure, that Dr. Buckland broadly assumes what I have elsewhere termed the metamorphic theory, having stated in his sixth chapter, that beds of mud, sand, and gravel, deposited at the bottom of ancient seas, have been converted by heat and other subterranean causes into gneiss, mica slate, hornblende slate, clay slate, and other crystalline schists. But if this transmutation be assumed, it must also be admitted, that the obliteration of the organic remains, if present, would naturally have accompanied so entire a change in mineral structure. The absence, then, of organic fossils in crystalline stratified rocks, of whatever age, affords no presumption in favour of the non-existence of animals and plants at remote periods.

The author, however, in another part of his Treatise contends, that even if the strata called primary, once contained organic remains, there is still evidence in the fundamental granite of an antecedent universal state of fusion, and consequently a period when the existence of the organic world, such as it is known to us, was impossible. There was, he says, one universal mass of incandescent elements, forming the entire substance of the primæval globe, wholly incompatible with any condition of life which can be shown to have ever existed on the earth*. Believing as I do in the igneous origin of granite, I would still ask, what proof have we in the earth's crust of a state of total and simultaneous liquefaction either of the granitic or other rocks, commonly called plutonic? All our evidence, on the contrary, tends to show that the formation of granite, like the deposition of the stratified rocks, has been successive, and that different portions of granite have been in a melted state at distinct and often distant periods. One mass was solid, and had been fractured before another body of granitic matter was injected into it, or through it, in the form of veins. In short, the universal fluidity of the crystalline foundations of the earth's crust, can only be understood in the same sense as the universality of the ancient ocean. All the land has been under water, but not all at one time; so all the subterranean unstratified rocks, to which man can obtain access have been melted, but not simultaneously.

* Buckland's Bridgewater Treatise, vol. i. p. 55.

Nor can we affirm that the oldest of the unstratified rocks hitherto discovered, is more ancient than the oldest stratified formations known to us; we cannot even decide the relations in point of age, of the most ancient granite, to the oldest fossiliferous beds.

But why, I may ask, should man, to whom the early history of his own species, and the rise of nations presents so obscure a problem, feel disappointed if he fail to trace back the animate world to its first origin? Already has the beginning of things receded before our researches to times immeasurably distant. Why then, after wandering back in imagination through a boundless lapse of years, should we expect to find any resting-place for our thoughts, or hope to assign a limit to the periods of past time, throughout which, it has pleased an omnipotent and eternal Being to manifest his creative power?

But it is not my intention to advert now to these and other points, on which I happen to differ from Dr. Buckland. I would rather express the gratification I feel in finding myself in perfect accordance with him on so many subjects. His work is admirably adapted to convey instruction on organic remains, and other departments of geology, both to beginners and to those well versed in the science, and is characterized throughout by a truly philosophical spirit, which betrays no desire to adhere tenaciously to dogmas impugned or refuted by the modern progress of science. On the contrary, the author has abandoned several opinions which he himself had formerly advocated; and although still attached to the theory which teaches the turbulent condition of the planet, when the lias and other fossiliferous rocks were formed, and the general insufficiency of existing causes to explain the changes which have occurred on the earth, he yet refers in almost all parts of his book to the ordinary operations of nature to explain a variety of phenomena, once supposed to be the result of causes different in kind and degree from those now acting.

I have now, gentlemen, only to offer you my acknowledgements for the high honour conferred upon me by my election to fill the President's chair for the last two years; and it is a source of great satisfaction to me to feel assured of the continued prosperity and usefulness of the association, when I resign my trust into the hands of a successor so distinguished for his zeal, talents, and varied acquirements, as Mr. Whewell.

MINERAL RESOURCES OF AMERICA.

[From a correspondent of the *Morning Chronicle*.]

PHILADELPHIA, MARCH 1.—The very spirit of the gnomes has seized upon nearly half the legislatives of the states of North America. Gems, metals, and other hidden treasures of the mine glitter before the prophetic fancies of senators and law-givers, and the earth receives a double value in their estimation from the supposed riches which it every where conceals. Accordingly, by way of unfathoming its dark mysteries, we find the different governments engaged in appointing surveyors for the purpose of obtaining geological and mineralogical surveys of their territories. In Pennsylvania and New York these pursuits are followed up with peculiar ardour, and the labours of the scientific have resulted in inexhaustible discoveries of coal-beds, iron, lead, &c. The same remarks will also apply to Virginia, the Carolinas, and Georgia, with their veins of gold. The subterranean riches of Tennessee, Alabama, and the immense wealth in lead and iron of Missouri, Wiscousin, Illinois, and Indiana are also exposed; and even Little Delaware and far-off-Michigan—that land of the lakes—have granted large sums for scientific surveys. The effect of all this will be to open new sources of wealth and industry; and I predict that within a few years America will become a great exporting country in the articles of lead and iron, as well as anthracite and bituminous coal. The only thing wanted is labour. The giant arms of the steam-engines already perform wonders here; but it will not be until population increases, and labour becomes available at half its present price, that America will be able to compete with Europe in these matters. She is, however, making rapid strides; and it has been a remarkable feature in the winter's meetings of state legislatures that geological and mineralogical surveys have been appointed and encouraged with unwonted munificence and liberality. In this, as in all other enterprises of a national character, the American by-word of "go a-head" may be very appropriately adopted as a motto. I cannot help recommending the British iron-masters who supply America with rail-road and other iron to make hay while the sun shines; for most assuredly every possible effort is being made in this country to do without importing that valuable article from other nations.

BRITISH MUSEUM.—The report of the House of Commons upon the number of visitors to the British Museum, just published, shows the advantage of its being open in the holidays, "Lord Stanley writes, 23,985 visited the Museum on Easter Monday; every thing was regular and quiet, and no injury done." The above number is greater than that of the visitors during the whole month of April in former years. It is open till seven in summer.

POWERFUL GALVANIC BATTERY.—The most powerful combination that exists, is in the laboratory of the Royal Institution. It consists of 200 instruments, connected together in regular order, each composed of ten double plates, arranged in cells of porcelain, and containing in each plate thirty-three square inches; so that the whole number of double plates is 2000, and the whole surface 128,000 square inches. This battery, when the cells were filled with sixty parts of water, mixed with one part of nitric acid and one part of sulphuric acid, afforded a series of brilliant and impressive effects. When pieces of charcoal, about an inch long and one-sixth of an inch in diameter, were brought near each other, (within the 30th or 40th part of an inch), a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness; and, by withdrawing the points from each other, a constant discharge took place through the heated air, in a space equal at least to four inches, producing a most brilliant ascending arch of light, broad and conical in form in the middle. When any substance was introduced into this arch, it instantly became ignited—platina melted as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plumbago, rapidly disappeared, and seemed to evaporate in it. Such are the decomposing powers of electricity, that not even insoluble compounds are capable of resisting their energy; for even glass, sulphate of baryta, fluor spar, &c., when moistened and placed in contact with electrified surfaces from the galvanic apparatus, are slowly acted upon, and the alkaline, earthy or acid matter, carried to the poles in the common order. Not even the most solid aggregates, nor the firmest compounds, are capable of resisting this mode of attack; its operation is slow, but the results are certain; and sooner or later, by means of it, bodies are resolved into simple forms of matter.

FOSSIL INFUSORIA.—Fossil infusoria have been eaten in Lapland in times of great scarcity. M. Retzius, Professor of Anatomy at Stockholm, has recently written thus to M. Ehrenberg:—"Through the kindness of M. Berzelius, I have received some fragments of the siliceous deposit of Franzensbad, sent by you to him. The carapaxes of the fossil infusoria contained in this deposit, made me think of a mineral substance vulgarly called Bergmehl (flour of the mountains), analyzed and described by M. Berzelius in the 'Annales de Poggendorf' for the year 1833. This flour of the mountains contains silex, an animal substance, and the *crénique* acid (*quellen saure*), discovered by this great chemist. The Laplanders mix the bergmehl, when a famine takes place, with the flour of corn and bark, in order to make bread. They fed in this manner in 1833, in the little district of Degerfors, on the frontiers of Lapland, in the sixty-fourth and sixty-fifth degrees of latitude. On examining the mountain flour which is considered by these superstitious people to be a gift from the great spirit of the forests, I have discovered nineteen different forms of infusoria, with siliceous carapaxes, of which I send you drawings. The whole of the mineral is composed of them, and the conjecture which I formed on its analogy with the deposit at Franzensbad, proves to have been well founded. M. Ehrenberg has received the mineral flour from Lapland, and several of the infusoria which it contains are supposed to be still living near Berlin. The infusoria are *eaten* in Degerfors—I do not say that the inhabitants are nourished by them."—*Baron de Humboldt.*

IMPORTANT TO ADVENTURERS IN COLLIERIES.—About twelve months ago, a new colliery shaft was begun by George Bruin, Esq., on the flat to the S. E. of Llanelly, called the "St. George's Pit." A great quantity of water was met with during the first seven or eight fathoms; the ground being composed of two small atmospheric engines and perseverance, the shaft was carried down to hard ground, or rock, and the manager (Mr. John Morgan, of Llanelly), then turned his attention to walling up the pit, so as to exclude the great body of water continually pouring in; and this has been effectually achieved by the following process:—The pit is bricked up just outside the original timber in a circular form, the bricks being made in a mould to suit the curve and set in fine Aberthaw lime; then an interior wall of stone and Aberthaw mortar was made, leaving a cavity of a few inches between it and the brick facing; in this cavity fine Aberthaw lime in dust is well rammed, which, it is believed, will set, should any water pass through the internal wall; at all events, the process has been completed some weeks, and the pit is quite dry; which will save a large proportion of the capital, that otherwise would have been necessary in erecting a pump engine of great power, and afterwards keeping it at work.—*Cambrian.*

RAILWAY SPECULATORS.—Some extraordinary evidence was given, it is said, before one of the Parliamentary committees, as to the means used to obtain the amount of subscriptions required by the standing orders of the House of Commons. A Jew, whose name bore a resemblance to that of a great capitalist, signed his name for 25,000*l.* This individual had neither house nor lodging: he received 4*l.* for signing the deed. Persons were employed to procure signatures, who received 5s. for each, giving four to the signer, and keeping one for themselves. The names of the clerks were put down for 500 shares each. One man's name appears for 32,000*l.*, and another for 20,000*l.* A news-agent signed for 10,000*l.* and his son for 3000*l.*, and one of the solicitors for 1000 shares. One of the secretaries to the company procured signatures to the extent of 215,000*l.*; another to the extent of 86,000*l.*; and a third to the amount of 260,000*l.* Several of the directors, whose names stood for 10,000*l.* each, caused the figures to be altered to 20,000*l.*, on the day before the deed was sent to be deposited in the proper office.—*Observer.*

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The Mining Journal

AND COMMERCIAL GAZETTE.

SUPPLEMENT---XVI.

REVIEWS.

Transactions of the Institution of Civil Engineers. Vol. I. Weale, London. 1836.

[*Continued from page 58.*]

In our former notice of this work, we briefly glanced at the origin of those pursuits which now constitute the profession of the engineer, tracing the efforts of mankind to achieve those stupendous and difficult works, which form the proudest monuments of the dominion of mind over matter, from the first rude, yet wonderful attempts, down to our own times, when all the resources of art and science are made available to these magnificent and beneficial operations. In the admirable introduction to the volume before us, the history and progress of engineering, in our own country, was traced with great ability, and from this portion of the work we extracted at considerable length. The introduction closes with the names of Rennie and Telford, thus drawing an appropriate line between those great men, whose genius now lives only in their works; and those living competitors for fame and distinction, from whose labours the volume itself has, in a great measure, resulted; for some of its respected contributors, among whom we may name the late Mr. Tredgold, have not, we regret to say, survived to witness its appearance.

Thus pausing, as it were, between the present generation and the past, we may briefly glance at the general nature and tendency of some of those great engineering efforts which, within the last century, almost, indeed, within the last half of it, have impressed a new feature on the aspect of Great Britain.

The commercial character of the English nation—the consequent importance of inland navigation, by means of rivers; or where that does not exist, of a similar communication by artificial means—and the necessity for safe and commodious harbours for our shipping, were the causes which determined the direction of many of our earlier engineering efforts. It is interesting to observe, that the importance of a free and convenient communication, by means of our navigable rivers, was so well understood, even in the thirteenth century, that it was provided for by an express clause in the Magna Charta; and subsequent enactments of a similar nature were made in several of the succeeding reigns.

The improvement of river navigation, by artificial means, does not, however, appear to have made much progress in this country till the latter part of the seventeenth century, when locks were first constructed upon the little river Wey, in Surrey; a contrivance said to have been brought from the Netherlands, by Sir Richard Weston, by whose exertions this river was first rendered navigable. We need hardly observe, that inland navigation, by means of canals, is of still later date: at the commencement of the reign of George the Third, in 1760, we believe, no canal had yet been opened for public use in this country, although the Duke of Bridgewater had nearly completed the great water communication which he had, two or three years previously, entrusted to the direction of the celebrated Brindley—the first work of the kind in England. At the present time the country is intersected in every direction by canals, reaching almost to its remotest extremities; and we are afraid to quote, from memory, either how many thousand miles in length have now been executed, or how many millions have been expended upon operations of this kind.

In the construction of these works, natural obstacles, apparently insurmountable, have been successfully overcome; tunnels, frequently exceeding a mile in length, have been formed—noble aqueducts have been constructed across deep valleys—and high summit levels have been attained, on which the vessel floats, in apparent contradiction to the laws of gravity: thus, the barge which leaves the Thames at Brentford, proceeding by the Grand Junction Canal, on arriving in the vicinity of Berkhampstead, in Hertfordshire, has attained a summit level of four hundred feet above the river at London, and is thus, *by water conveyance*, actually placed in a position higher than the ball and cross of St. Paul's. The fine aqueduct of Chirk, and the still more noble one of Pont y Cyssylte, in the vale of Llangollen, spanning, in its wide embrace, the broad and beautiful valley below, and suspending the vessels, as they cross it, high in the air: the Dee, flowing undisturbed beneath, in a romantic stream, environed with lofty trees—these and other works may also be mentioned as among the triumphs of engineering skill in executing those great lines of inland navigation, which have so materially benefitted the commerce of this country: nor can we omit a passing tribute of admiration to that magnificent work, the Caledonian Canal, in which the skill of man has so ably co-operated with the work of Nature, in opening a water communication across the northern portion of our island.

In providing for the safety and convenience of our shipping, works of equal magnitude and importance have been executed—the noble docks of the metropolis, of Liverpool, of Hull, and our other maritime towns, while of the highest value to the country, afford striking examples of the knowledge and skill of the engineers who planned and superintended them, and of the wealth and enterprise of the nation which found the capital required for their construction.

Nor can we pass over, even in this brief and hasty notice, the stupendous Breakwater, which, stretching its giant arms across Plymouth Sound, opposes a barrier to the raging billows of the Atlantic; and, by a grand exertion of art, affords shelter to the otherwise unprotected vessels, in a spot where such terrible effects have often resulted from their fury, prior to the construction of this grand and useful work. The neighbouring Eddystone Lighthouse, that enduring monument of the genius of Smeaton, must also be mentioned with respect, in glancing over the efforts of our engineers, to afford protection and security to the British navy—and many similar works of high merit might also be enumerated, did it fall within our limits to notice them.

As regards public convenience, and increased facilities of communication, leaving entirely out of view the more recent improvement of railway transit, we may name the bridges of the metropolis, all of them the work of the last century, as works of the highest merit and utility—works which, should London, in the course of centuries, fall to decay, as other great cities have done, will probably remain almost the sole vestiges of her former grandeur. Nor must we omit the great Holyhead road, with its noble suspension bridge across the Menai Strait—the bold and useful roads and bridges of the Highlands; and the similar public works which have been executed in Ireland—perhaps the most important means which have yet been practised to ameliorate the state of that country—in our brief recapitulation of the nature and objects of the more prominent works of modern engineering, with which this country is both enriched and adorned, and which have been the means of giving so strong an impetus to the manufacturing and commercial wealth of Great Britain.

While the surplus capital, which had resulted from the commercial enterprise and industry of this country, was thus profitably invested in works of public utility, almost co-extensive with the soil itself, the genius of Watt, silently exercised in the factory of Soho, was preparing a new and mighty auxiliary, both for the operations of the manufacturer and the engineer. The steam-engine, before limited in use—its giant powers fettered by imperfect development, came from his hands almost a new creation—docile in its management, and universal in its application—giving rise to the almost prophetic lines of Darwin—

> "Soon shall thy arm, unconquered steam, afar,
> Drag the slow barge, or drive the rapid car—"

and laying the foundation for events, both moral and political, which must involve the future destinies of the whole human race.

Such then, was the general nature of the works effected by the past generation of British engineers, leaving still an ample field for their successors, in a profession which seems likely hereafter to absorb a large portion of that wealth, which is constantly accumulating in this and other countries, and by directing it into channels of permanent utility (at least when not under the influence of public caprice, unfortunately at times too prevalent), to render great and lasting benefits to all classes of society.

Turning, however, from past events to those now passing before us, we shall find, that by the exertions of the present race of engineers, a new field is already opened—a field far more extensive than that in which their predecessors laboured. The steam-engine has arrived at a state of perfection probably never contemplated by Watt; and this great improvement, we may observe, has been effected by the meritorious and combined exertion of many individuals—exertions which, we regret to say, have been most inadequately rewarded.

Railways and locomotive engines have suddenly sprung from comparative obscurity and limited application, and have taken their stand as one of the most extraordinary and useful applications of modern practical science—applications, which bid fair almost to annihilate our present ideas of time and space, and to produce a facility of communication productive of the most important moral and physical consequences, altering, indeed, in no small degree, the aspect of society.

Even the slow and tedious rate of canal conveyance, apparently the result of immutable physical laws, may, as we have now reason to believe, be accelerated to an extent which would formerly have been deemed utterly impracticable. To whatever point, indeed, we direct our attention, our dominion over the physical creation seems to be almost indefinitely extending, and unless prevented by our own folly, it is needless to expatiate on the benefits to mankind which must thus arise.

We may now turn to the volume under consideration, and there we shall find developed in the numerous and instructive papers which it contains, the powerful resources which science has placed under our command. In extracting from its pages, we shall, however, confine ourselves in a great measure to those subjects which relate either directly or indirectly to mining or subterranean operations, and which fall therefore, more immediately within the province of our publication; and it is for this reason that we have first endeavoured to give a brief preliminary view of the general scope and design of engineering operations, previously to confining ourselves to the more technical details with which we are chiefly interested, and to which we shall next direct attention.

Passing over several papers, on subjects foreign to our views, we come to a short communication from Mr. Neilson, the gentleman who first discovered the use and application of the "hot-air blast." This paper is interesting, as conveying some of the earlier details of this highly important invention, to which, on different occasions, we have devoted a considerable space in our columns; and being brief in itself it may be quoted entire:—

"I feel much pleasure in being able to comply with your request in mentioning to you what I conceive to be the nature of the advantages likely to be derived by the iron trade, and the country generally, from my invention of the hot blast, and at the same time, I shall very willingly state the circumstances, agreeably to your request, which, in the first instance, led me to direct my attention to the improvement of the process of iron-making.

"About seven years ago, an iron-maker, well known in this neighbourhood, asked me if I thought it possible to purify the air blown into blast furnaces, in a manner similar to that in which carburetted hydrogen gas is purified; and from this gentleman's conversation, I perceived that he imagined the presence of sulphur in the air to be the cause of blast furnaces working irregularly, and making bad iron in the summer months. Subsequently to this conversation, which had in some measure directed my thoughts to the subject of blast furnaces, I received information that one of the Muirkirk iron furnaces, situated at a considerable distance from the engine, did not work so well as the others; which led me to conjecture that the friction of the air, in passing along the pipe, prevented an equal volume of the air getting to the distant furnace, as to the one which was situated close by the engine. I at once came to the conclusion, that by heating the air at the distant furnace, I should increase its volume in the ratio of the known law, that air and gases expand as 448 + temperature.

"Example.—If 1000 cubic feet, say at 50° of Fahrenheit, were pressed by the engine in a given time, and heated to 600° of Fahrenheit, it would then be increased in volume to 2104·4, and so on for every thousand feet that would be blown into the furnace. In prosecuting the experiments which this idea suggested, circumstances, however, became apparent to me, which induced the belief on my part, that heating the air introduced for supporting combustion into air furnaces, materially increased its efficiency in this respect; and with the view of putting my suspicions on this point to the test, I instituted the following experiments:—

"To the nozzle of a pair of common smith's bellows, I attached a cast-iron vessel, heated from beneath, in the manner of a retort for generating gas, and to this vessel, the blow-pipe, by which the forge or furnace was blown, was also attached. The air from the bellows having thus to pass through the heated vessel above-mentioned, was consequently heated to a higher temperature before it entered the forge fire, and the result produced, in increasing the intensity of the heat in the furnace, was far beyond my expectation, and so evident, as to make apparent to me the fallacy of the generally received opinion, that the coldness of the air of the atmosphere in the winter months, was the cause of the best iron being then produced.

"In overthrowing the old theory, I had, however, established new principles and facts in the process of iron-making, and by the advice and assistance of Charles M'Intosh, Esq., of Crossbasket, I applied for and obtained a patent, as the reward of my discovery and improvements.

"Experiments on the large scale to reduce iron ore in a founder's cupola, were forthwith commenced at the Clyde Iron Works, belonging to Colin Dunlop, Esq., which experiments were completely successful, and in consequence, the invention was immediately adopted at the Calder Iron Works, the property of William Dixon, Esq.; where the blast being made to pass through two retorts, placed on each side of one of the large furnaces, before entering the furnace, effected an instantaneous change, both in the quantity and quality of iron produced, and a considerable saving of fuel.

"The whole of the furnaces at Calder and Clyde Iron Works were, in consequence, immediately filled up on the principle of the hot-blast, and its use at these works continues to be attended with the utmost success; it has also been adopted at Wilsontown and Gartshirrie Iron Works, in Scotland, and at several works in England and France, in which latter country I have also obtained a patent.

"The air, as at first raised to 250° of Fahrenheit, produced a saving of three-sevenths in every ton of pig-iron made, and the heating apparatus having since been enlarged, so as to increase the temperature of the blast to 600° Fahrenheit and upwards, a proportional saving of fuel is effected; and an immense additional saving is also acquired by the use of raw coal instead of coke, which may now be adopted. By thus increasing the heat of the blast, the whole waste incurred in burning the coal into coke, is avoided in the process of iron-making.

"By the use of this invention, with three-sevenths of the fuel which he formerly employed in the cold-air process, the iron-maker is now enabled to make one-third more iron of a superior quality.

"Were the hot-blast generally adopted, the saving to the country in the article of coal, would be immense. In Britain, about 700,000 tons of iron are made annually, of which 50,000 tons only are produced in Scotland; on these 50,000 tons, my invention would save in the process of manufacture, 200,000 tons of coal annually. In England the saving would be in proportion to the strength and quality of the coal, and cannot be computed at less than 1,520,000 tons annually; and taking the price of coal at the low rate of four shillings per ton, a yearly saving of 296,000*l.* sterling would be effected.

"Nor are the advantages of this invention solely confined to iron-making: by its use the founder can cast into roods an equal quantity of iron, in much less time, and with a saving of nearly half the fuel employed in the cold-air process; and the blacksmith can produce in the same time one-third more work, with much less fuel than he formerly required.

"In all the processes of metallurgical science, it will be of the utmost importance in reducing the ores to a metallic state."

Mr. Neilson's paper is followed by a valuable communication from Mr. Farey, "On the relation between the temperature and the elastic force of steam, when confined in a boiler containing water," which, however, we pass over as too technical to interest the general reader, taking our next extract from a communication by Mr. Walker, the President of the Institution, on ventilating and lighting tunnels, a subject lately brought much before public attention:—

"The want of ventilation and light seems the greatest objection to tunnels on railways and canals. An attempt is making to remedy both these evils in the tunnel now (1832) forming on the Leeds and Selby Railway, near Leeds, by a plan which is simple, not attended with much expense, and likely to be at least partially successful. A short description will suffice to make it understood.

"The tunnel is nearly half a mile long; the greatest depth from the surface about eighty feet. As three shafts were required for raising the excavation during the progress of the work, it occurred to me, that by placing them at nearly equal distances, and walling them in a permanent manner, they might be left open to the surface afterwards. A strong elliptical casting, about eight feet long and five feet wide, has therefore been built in the arch of the tunnel, and over this a circular shaft or well, ten feet diameter, raised in strong brickwork. If it be found expedient to cover the well as a protection from the rain, it may be done with glass, raised on columns of such height as to admit a free circulation of air between the surface of the ground and the roof.

"So much for ventilation. But as the light afforded by the shafts is confined to the space immediately below them, the desideratum is to throw it along the tunnel, and I think this may be done so as to give a useful light by means of plane reflectors of tinned iron placed on the ground between the two lines of railway, at such an angle as to reflect the light where it will be most useful. The idea was suggested by the rum vaults in the West India Docks, where the marks on the casks are ascertained by catching the faint light from the windows upon a small piece of tin plate, and throwing it on the casks. Those who have seen this done have generally been surprised at the useful effect produced; but in the case of the tunnel, the light coming directly down the shaft is more powerful, and the effect of the experiments I have made has much exceeded my expectations. I shall take care that the results of any future observations be communicated to the Institution.

"P.S.—In compliance with the promise given in the preceding paper, I have procured from Mr. George Smith, the resident engineer on the Leeds and Selby Railway, the annexed observations on the subject containing the result of his recent experience. Though they do not in all respects realise the expectations I had formed from the first experiments which were made before the tunnel was completed, or the railway formed, I may remark, that while the shafts seem to be very serviceable for ventilation, the light they supply is useful to those whose duties require them to pass through the tunnel on foot or unaccompanied with an engine. Mr. Smith's remarks are dated Dec. 1835, and are as follows:—

"'At the present period when there are so many railways in progress and in contemplation, many of them with tunnels of considerable length, the following observations on the effects of the Locomotive Engines, working in the tunnel of the Leeds and Selby Railway, may be interesting to those who have not the opportunity of witnessing those effects daily and under all circumstances.

"'The tunnel of the Leeds and Selby Railway is nearly half a mile in length, situated at the commencement of that railway at the Leeds end, and has a slight ascending inclination in going from Leeds. The situation and inclination cause a considerable difference in the quantity of steam discharged from the chimneys of two engines travelling in opposite directions.

"'The ascending engine labouring at a first start against the inclination, to get into speed, (which is scarcely done before leaving the tunnel), causes a great expenditure of steam, &c., while an engine coming in the opposite direction, having a clear fire, and every means taken to prevent the generation of steam, by opening the fire-door and pumping water into the boiler, expends very little, and that through the safety valve, the smoke from the chimney not being perceptible. It will therefore be necessary to detail the effect of an engine passing through the tunnel from the Leeds end only.

"'The fires of the engines are made up, previous to starting, with coke

mixed with coal, to hasten the ignition of the former; the smoke from the coal is of course mixed with that of the coke and steam, adding to the density of what escapes from the chimney, and continues to do so for some time, frequently through the whole length of the tunnel: but notwithstanding this, the tunnel is generally clear in less than five minutes after; in many cases nearly as soon as the engine has left it. This of course is governed, in a great measure, by the force and direction of the wind. In foggy weather there being little or no wind, the smoke from the coal is left after the steam is condensed, and forms itself into a cloud which sails slowly along the roof, travelling at the rate of from two to three miles per hour; a great part of it ascends the shafts, but from the heavy state of the atmosphere, a considerable portion passes them and discharges itself at one end of the tunnel. It should here be mentioned, that the entrances into the shaft from the tunnel are much contracted, having not more than five feet in the longitudinal, and eight feet in the transverse direction of the tunnel, and much of the smoke, &c., passes on each side of the shafts; and in consequence of the sluggishness of the draught on those days, the lower part of the cloud has not sufficient time to alter its course up the shafts.

" 'Two engines, having coal mixed with the coke in their fire-boxes, left the Leeds depôt during a very heavy morning, and followed each other quickly through the tunnel; each left a cloud behind, the one keeping at a considerable distance from the other. The smoke (the steam appearing to have been condensed) seemed to have lost its usual sulphurous smell, and resembled a dense fog—the deneness appearing greater from the darkness of the tunnel; and such is the freedom of those clouds from anything unpleasant, that passengers in close carriages are not aware of having passed through them, which they do almost instantaneously.

" 'Passengers are never annoyed with the steam, &c., from the chimneys of the engines, as it does not descend low enough, except on heavy days, and even then, the progress of the engines carries them forward before it is so low as to affect them.

" 'From the effects described above it appears evident, that in tunnels situated only a short distance from the starting-place, it is extremely probable little or no inconvenience will be felt by the passengers passing through them.

" 'Previous to the opening of the Leeds and Selby Railway, great doubts were entertained by many, and among others a celebrated lecturer, as to the fitness of the atmosphere for respiration, in a tunnel worked by locomotive engines; now that the incorrectness of that idea is fully proved, as far as regards a tunnel half a mile long, those doubts are still entertained by many individuals, as to tunnels of much greater lengths. These doubts will probably prove as groundless as the former ones, for the following reasons:—

" 'A considerable quantity of the steam from the engines ascends the shafts at all times, but there is no doubt a large portion is also condensed in the tunnel; and were there no shafts at all, the steam could not remain long uncondensed, surrounded, as it will ever be, by walls always at an even temperature, a short distance from the ends of the tunnel, saturated with moisture, and the surface in many parts covered with water.

" 'The coke, particularly when in a high state of combustion, gives out little smoke, and, from its having passed through the steam, loses, like the coal, the greater part, if not all its offensiveness; and mixing with the air that has been used for combustion, will, from its buoyancy, readily find its way along the top of the tunnel to the first shaft, and make its escape up it.

" 'Two great inconveniences in tunnels, are noise and want of light; the former it will be difficult to remedy, the latter may be easily so, by carrying oil or portable gas lamps with the carriages. Oil lamps are used with the evening trains, during the winter months, on the Leeds and Selby Railway, and give sufficient light in their passage through the tunnel. Some experiments were made with tin reflectors at the bottom of the shafts, and although the light reflected was sufficient to read the larger print in a newspaper advertisement, at all parts of the tunnel (there being three shafts), it is very doubtful whether lighting tunnels by reflection will be of use for passengers. The rays of light are thrown on the walls so very obliquely, that, from the rough and dirty state of their surface, few are again reflected from them, and these are too feeble for the eye to accommodate itself to so great a transition during the time a train would be passing through a tunnel of moderate length. A passenger sitting in a close carriage, having only the walls to look at, would, under such circumstances, fancy himself in total darkness, although the tunnel generally might be moderately light. The difficulty of keeping reflectors clean from the effects of damp, steam, &c., would be a considerable expense in a long tunnel; and it must also be borne in mind, that the moment an engine has passed a reflector, it becomes of no use to the train attached to that engine, as it is immediately surrounded with steam, &c., forcing its way up the shaft, and the next reflector, in a long tunnel, would probably be a quarter of a mile from the one thus thrown into darkness.' "

It will be seen that a large portion of this communication is from the pen of Mr. George Smith, resident engineer of the Leeds and Selby Railway, and it is, therefore, highly deserving of attention, as containing the result of much recent experience on the subject, authenticated by such high authority as Mr. Walker.

From Mr. Rendel's memoir on the construction of the Lary Bridge, near Plymouth, in which the diving bell seems to have been used with much success, we make the following short extract:—

" The next operation was to cut off the bearing piles to their proper depth, and to pave and grout the spaces between them. The usual mode of cofferdams was manifestly inapplicable to such a bed of sand; I, therefore, in an early stage of the works, proposed to the contractors, that the pile heads should be levelled, and the spaces between them paved by means of a diving bell. To save expense, this bell was made of wood, and, with the necessary machinery, was finished and put to work within six weeks from the time it was determined on. With its assistance, the works were carried on with expedition and success. When in operation, it contained two men, who, being provided with the necessary instruments for cutting off the piles, paving the spaces between them, &c., continued at work for four hours, when they were relieved by two others."

One of the most interesting papers in the volume to our mining friends, must be that by Mr. T. Wicksteed, "On the effective power of the high-pressure expansive condensing steam-engines, commonly in use in Cornish Mines," for a copy of which we were a short time since indebted to the attention of the author.

It had long been considered by the engineers of London, and other parts of the kingdom, that the reports of the duty of the engines employed in pumping in Cornwall, were greatly exaggerated; and much doubt has been expressed as to the reality of the great improvements said to have been introduced by the Cornish engineers. Any misapprehension of the kind must have been long since removed by the reports of Mr. Galloway* and of Sir John Rennie; but did any doubts still remain, we think they must be set at rest by the paper we have referred to, which contains the results of Mr. Wicksteed's observations upon several steam-engines in Cornwall, during a visit to the county for that express purpose.

From this interesting paper we shall now proceed to make extracts of some length. Mr. Wicksteed thus describes the nature of his mission, and some of the engines to which his attention was directed, together with other particulars relative to the subject:—

" Having received instructions from the court of directors of the East London Water-works to visit the mines in Cornwall, for the purpose of making inquiries about the Cornish engines, I left London upon the 1st of August last, and returned upon the 20th of the same month.

" My friends, Mr. John Taylor and Mr. Grout, kindly gave me letters of introduction, which enabled me to see any engine I was desirous of viewing.

" The first mines I visited were the Wheal Friendship copper mines, near Tavistock, Devonshire, and the Redmoor and Holmbush copper, and the Wheal Brothers silver mines, near Callington, Cornwall. At the Redmoor mine I saw an engine with a fifty inch cylinder, erected by Messrs. Petherick and West. The mine had not been long at work; the shaft was not more than 150 feet deep; there were two shafts with pumps in, and one was about 560 yards distant from the engine; the motion was communicated by means of horizontal bars, suspended by pendulum rods. The engine was working about two strokes per minute throughout the twenty-four hours; the work done was light, probably not equal to more than five horses' power; it consumed only three and one third imperial bushels of coals per twenty-four hours. The engine had been worked the previous fortnight with turf cut off the neighbouring moor, at a cost of eight-pence halfpenny per twenty-four hours; it required eighteen feet square of turf, about two inches thick, to keep the steam up for that time. I mention this to show that when a large engine is erected to clear a mine, although in the first instance the work it has to do is not proportioned to its size, nevertheless, the consumption of fuel is nearly in proportion to the work done.

" As regards the use of turf, it is evident, as these boilers were constructed with the intention of using coal as fuel, when the depth of the mine and the quantity of water increased, that turf could not be used without an alteration in the fire-places, the bulk of turf required being much greater than that of coal. Mr. Grout has since informed me, that he has ordered an engine and boilers for one of his mines, and that the boilers are to be constructed with a view to the use of turf only.

" The next engine that I saw was one at the Fowey Consolidated mines, near St. Blazey. The cylinder was eighty inches, the pump stroke nine and a quarter feet, the duty was, in August, equal to 83,296,000 lbs., raised one foot high, with an imperial bushel, or eighty-four pounds of coals; it consumed about a bushel or eighty-four pounds of coals per hour. This is a most splendid engine, and does greater 'duty' than any other engine in Cornwall; the construction of the valves and other parts of the engine is so perfect, that although its load was equal to about 51,000 lbs., the hand-gear might be worked by a boy of ten years of age, as far as strength was required; I worked it myself with perfect ease; whereas, although the load upon one of our engines of thirty-six inches cylinder is only about 12,000 lbs., it requires not only a strong, but also a weighty man to work it.

" The hand-gear is all bright work, and finished in first-rate style. The quantity of bright work in an engine of course depends upon the taste of the person ordering it, and I certainly saw many Cornish engines of longer standing than the one in question, that displayed very little bright work; but that it can be executed as well in Cornwall as in any other county in England must appear evident to those who have seen this engine, and the founderies or engine manufactories at Hayle. At the latter place I saw an eighty inch cylinder, twelve feet long, in the boring machine, and could not perceive a flaw in it.

" I was very much struck with the ease with which the engine in question appeared to work; there was scarcely any noise, the greatest was that of the steam in its passage through the expansion valve. To one who had been used to the noise of the pumping engines in London, it appeared remarkable.

" The reason that this engine does more work than any other in Cornwall is, in my opinion, owing chiefly to the construction of the boilers, which are different to the generality, inasmuch as they have an internal tube, of about twenty-one inches diameter, passing through the main flue of the boiler, extending from the back part of the boiler as far as the bridge of the fire-place, dividing the flame as it passes from the fire-place, and thus where the heat is more intense the surface exposed to its action is greatest; there is also a tube of about the same diameter, and thirty-six feet long, around which the flue from the boilers passes before entering the chimney; into this tube the feed is sent before it passes into the boilers, and is previously heated to a temperature of 180° by means of the heat that might otherwise pass into the chimney unused.

" The engines that I next viewed were the following; viz.

50 inch cylinder		at Charleston,	Near St. Austell.
76	ditto	at East Crennis,	
66	ditto	at Polgooth,	
85	ditto	at the Consolidated Mines,	Near St. Day.
80	ditto	at ditto,	
30	ditto	at United Mines,	

" Although all of these engines were good ones, they were not equal to the Fowey Consols; as regards the last, viz. the thirty inch cylinder, the water that is raised out of the mine by this engine is conveyed by a pipe above ground to supply a water-wheel; and, although it is small and not of modern construction, it is doing nearly twice the '*duty*' of the London pumping engines of four times greater area in the cylinder. I mention this engine particularly, because it is doing precisely the same work that a water-works engine has to do in lifting water into a reservoir.

" I afterwards viewed the following engines; viz.

Two 80 inch cylinders		at Wheal Vor, near Helston.	
One 70	ditto	at North Roskear, near Redruth.	
60	ditto	at South Roskear, near ditto.	
80	ditto	at Wheal Darlington, near Marazion.	
30	ditto	at Wheal Providence, near St. Ives.	

" The thirty-inch cylinder at the United Mines, the eighty-inch cylinder at Wheal Darlington, and the thirty-inch cylinder at Wheal Providence, were raising the water out of the shafts to the *surface*, and I had, therefore, an opportunity of seeing it as it was thrown up, and I observed, that in every case, there were no bubbles of air mixed with the water, proving that the pumps were lifting 'solid' water (as it is termed in Cornwall), and not partly water, and partly air, as has been suggested by those who have no faith in the reports of the work done by the Cornish engines.

" The foregoing, with the exception of the engine at Wheal Jewel Mines, near St. Day, which was not at work while I was there, were all the engines that I saw.

" As the accuracy of these reports has been questioned, or, to use plainer language, as it has been asserted that they are false, and that the Cornish engines do not perform the work stated, it may be as well to explain how these reports are made.

" When the agents of a mine wish the 'duty' of their engines to be published, an accurate measurement of the lifts is made, and the diameter of the pumps, and other particulars, are recorded; a counter is fixed upon the engines, by Captain Thomas Lean (the gentleman who has been appointed by the proprietors of the mines to take an account of the work of their engines), and this counter has a Bramah's lock attached to it, the key of which he keeps. He visits each of the mines once per month, and takes an account of the strokes made by the engines during the preceding month. In some instances, there is another counter attached to the engine, which is open to the inspection of the engineer, agents, and engine-keepers.

" The coals are supplied by a distinct party, who has to account to the agent of the mines for the coals consumed per month; the engine-keepers write orders for the coals they require, and at the end of the month the quantity of coals on hand is measured and deducted; the orders are considered as vouchers, which, after having been examined and countersigned by Captain Thomas Lean, are passed. It is obviously the interest of the coal agent not to report a less quantity than actually is consumed, being accountable for the quantity used; he cannot, therefore, be supposed to combine with the engine-keepers, whose object, if dishonest, would be to report a less quantity.

" But supposing, for the sake of argument, that the engineers and the agents of the mines were so disposed, and could get these gentlemen to combine with them, for the purpose of making a false report, the insanity of such a proceeding will, I think, appear evident upon a perusal of the following statement.

" The engines in Cornwall are designed, the drawings made, and the construction and erection of the machinery superintended, by gentlemen who are appointed as engineers to look after the machinery of the mines. The castings are made, and the work designed by the said engineers is executed at two large 'foundries,' or engine manufactories, at Hayle.

" There are more than twenty engineers employed in the mines in Cornwall, all of whom are anxious to construct the best engine, as the parties producing the engines that do the best duty, obtain, of course, the most employment. It is, therefore, a matter of jealous attention on the part of these gentlemen to take care that no engine shall have undue credit for doing the most work. It happens occasionally, where a great improvement has been made, that doubts are expressed as to the accuracy of the reported duty; in such cases the engineers and agents of the other mines call upon the parties whose engine is reported as performing extraordinary duty, to allow them to prove it; this call is answered by fixing a time for the trial—the trial lasts for two or three days, during which time the engine is in the hands of the rival parties, who are on the watch to detect unfair play, if any should be attempted. If the result of this trial is favourable, the party in question receives due credit; if otherwise, his character as an honest man is lost. If this is not as severe a test of the accuracy of the reports as can be made, and not sufficient, then, indeed, prejudice must have its full swing, and no farther *proof* can be given, as gentlemen going into Cornwall from London and elsewhere, for the purpose of proving the truth of the statement made by the Cornish engineers, may with equal justice be charged with making false reports.

" The reported 'duty' is not necessarily the whole performance of the engine, the amount of which cannot always be obtained; it is, in fact, merely the weight of water lifted, multiplied by the height in feet to which it is raised, reduced to the number of pounds avoirdupoise raised one foot high, for every bushel of coals consumed, without reference to *friction*. Now as the friction of each engine, and the machinery worked by it, varies,—and as, although this friction has to be overcome, the amount of it is not reported, so the reported duty is not the whole performance of the engine; and, consequently, an engine which is reported as performing certain duty may, in fact, be doing as much work as another engine whose *reported* duty is greater.

" The pumps in the mines in Cornwall are worked, and the water raised, as the engine goes 'out of doors,' the force of the steam is employed to raise the heavy pump rods; these rods are in many instances so weighty that without counterbalances, or, as they are termed in the county, 'balance bobs,' the engine would not be sufficiently powerful to raise them,—for instance, in some cases the pump rods are 150 tons in weight, which is equal to 336,000 lbs. Now the greatest load upon any engine reported in September last, was under 100,000 lbs. It is therefore necessary to have 'balance bobs,' or beams, one end of which is connected by a rod to the pump rod, and the other is weighted with iron as a counterbalance. These beams are in many instances as large as the beam of a 100 horse Boulton and Watt engine; it is evident that these cannot be worked without friction. In other cases the same engine not only works the pump rods that are in the shaft immediately under the end of the engine beam, but also the pumps in distant shafts, by means of horizontal rods extending in some instances half a mile. These rods are supported either by pendulum rods or work on friction wheels; in these cases the friction must be great. It must also be borne in mind that there is more friction in a small cylinder, in proportion to its area, than in a large one, and, in fact, in all the bearings and working parts of the engine,—the power increasing as the squares of the diameters, while the friction increases as the diameters, directly. There are other sources of friction, but the above examples will be sufficient to prove that, although there appears a discrepancy in the reported duties of the Cornish engines, as *friction* is not taken into the account, it does not *necessarily* follow that an engine, whose *reported* duty is great, should be, in fact, superior to one whose *reported* duty is less.

" In addition to this, the *reported* duty, of the same engine doing the same work, may vary seven or eight per cent. at different times, merely in consequence of the different quality of the coals supplied."

Mr. Wicksteed proceeds to state " particulars of the Cornish engines, showing that they are not inapplicable to water-works purposes," from which we quote only the following concluding remark:—

" The Cornish engines, in which the before named arrangements have been adopted, do about three times more work, with the same quantity of fuel, than the common water-works pumping engines. As this has, however, been declared impossible, I will endeavour to prove the contrary by a comparison of the two engines."

Passing over the reasoning employed on this subject, we have the following observations with regard to the casing of the Cornish engines:—

" The casing of the cylinders, boilers, and steam-pipes is not new either, but I have never seen it carried to the same extent as it is at present in Cornwall.

" Great and deserved credit is due to the perseverance, energy, and ingenuity of the Cornish engineers for bringing the expansive engine to the state that it now is, and for the daily improvements which, although taken separately may appear trivial, are in the aggregate of great importance."

At the end of his communication, Mr. Wicksteed remarks—

" In conclusion, I beg to observe, that if the Cornish engines do the work that it is stated they do, and if they are applicable to water-works purposes, of both of which I have no doubt, then the saving is most important; for supposing instead of *three* engines, consuming 3000 tons of coals per annum, *one* could be erected doing the work of the three, and only consuming 1000 tons, assuming the price of coals delivered to be 18s. per ton, the saving in coals alone, without reference to the savings in the reduced number of engine-keepers and stokers, the current expenses of one engine instead of three, the wear and tear of machinery and buildings, would be 1800*l.* per annum."

There are many papers remaining which still require notice, but, anxious to do full justice to the valuable and interesting work before us, we shall reserve them for a future Supplement, when our review of the volume will be concluded.

Tables calculated to Facilitate Business in the Tin Trade.

Tables for ascertaining the Value of any Quantity of Black Tin, from 1 lb. to 10 tons, at any price from 20l. to 90l. per ton. By R. WELLINGTON. Bennett, Marazion. 1836.

These two little volumes are of a size and form adapted for the pocket, and consist of tabular matter, which must be extremely valuable to all parties engaged in the tin trade, as facilitating many calculations which are of constant occurrence. Mr. Wellington deserves much praise for the care and attention he has evidently bestowed on their compilation, as well as for the neatness displayed in getting up the works.

We believe these tables will be extensively used in the western counties; and we have much pleasure in making them still more widely known than at present, through the medium of our columns.

We extract, from the latter work, the following information relative to the tin coinages in Cornwall and Devon:—

" TIN COINAGES IN CORNWALL AND DEVON.

" THE QUARTERLY COINAGES WILL BE HOLDEN AT

" MORWELLHAM.—On the quarter day, if that be a Tuesday; if not, on the first Tuesday after the quarter day.

" CALSTOCK.—The day after Morwellham.

" ST. AUSTELL.—The Thursday and Friday of the same week as Morwellham and Calstock.

" TRURO.—The week after Morwellham, Calstock, and St. Austell.

" HELSTON.—The Monday and Tuesday of the week following Truro.

" HAYLE.—The Wednesday, Thursday, and Friday, of the same week as Helston.

" PENZANCE.—The week following Helston and Hayle.

" THE HALF QUARTERLY COINAGES WILL COMMENCE AT

" MORWELLHAM.—The Tuesday fortnight after the end of Penzance quarterly coinage; and so on to Calstock, St. Austell, Truro, Helston, Hayle, and Penzance; and at each place will be commenced on the same day of the week, and will be continued for the same periods respectively as the quarterly coinages.—Any tin brought to the coinage halls after four o'clock P. M. of the last days of the respective coinages, will stand over until the following coinage

" Notice is hereby given, by the proprietors of the trade carried on at the undermentioned blowing and smelting-houses, that, pursuant to the Act of Parliament, which came into operation on the 1st of January, 1835, all black tin will be hereafter weighed and purchased by the cwt., of 112 lbs., from which will be deducted a draft of 3 lbs. for every cwt., and also 3 lbs. for the remaining weight exceeding 56 lbs., in order to assimilate to the mode hitherto practised.

" BLOWING-HOUSES.—Higher, New.

" SMELTING-HOUSES.—Charlestown, Carvedras, Calenick, Trethellan, Angarrack, Chyandour, Trelissick, Treloweth, Trereife."

London Grand Junction Railway, and Sir Samuel Whalley, M.P. Letter to Robert Hay Graham. M. D. By ROBERT MCWILLIAM. Kirby, London. 1837.

London Grand Junction Railway, surnamed the Humbug. Second Letter to Robert Hay Graham, M. D. By ROBERT MCWILLIAM. Kirby, London. 1837.

These letters are written in a style of great acrimony, and exhibit a strong personal feeling between the author and Sir Samuel Whalley, and his co-directors of the London Grand Junction Railway. We, of course, know nothing of the transactions alluded to, except from the pamphlets in question, in which a strong case appears to be made out against both the feasibility of the undertaking, and certain proceedings connected with the formation of the company. Whether any, or what explanation has been offered, we have no knowledge, and, therefore, at once dismiss the personal controversy without remark, further than that the subject is well deserving of attention, both from the shareholders and those whose property will be interfered with by the proposed line.

We are not advocates for the formation of railways through the streets of crowded towns; the expense in such cases is enormous, and the consequent probability of profits to the shareholders is proportionally lessened. The great deterioration of property, occasioned by such works, should also be dispassionately compared with the expected benefits, and the danger, more especially from fire, which must arise from the use of locomotive engines, moving with great velocities through streets and buildings, should also be well considered. On this subject Mr. McWilliam has furnished an appendix, containing extracts from the evidence given before a committee of the Lords, by whom it was investigated—evidence which is well deserving of public attention.

* See " Mining Review," No. VI., p. 238.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. VIII.

EXPLOSION OF FIRE-DAMP IN A LEAD MINE.

NOVEL INSTANCE OF AN EXPLOSION OF FIRE-DAMP IN A LEAD AND SILVER MINE, IN THE HARZ, WITH A DESCRIPTION OF ITS REMARKABLE ORIGIN BY THE WORKS BEING DRIVEN INTO THE ANCIENT LEVELS OF THE HANSBRANNSCHWEIGER MINE.

[Communicated by DR. ZIMMERMANN, *Secretary of the Mines at Clausthal.*]

[*Concluded from page 59.*]

Thus matters stood on Saturday, the 10th of January, 1829, when the superintendent recommenced the operation in company with two other workmen. On clearing the bore-hole, by removing the augur, it became stopped up with the clay, and on boring through it a strong spout of water burst out. As the boring-rods were bent, and the term of the gang was nearly expired, they thought it most advisable to pack up the tools and return to the surface. The superintendent, however, returning to the spot, observed a singing and hissing noise; and had scarcely reached the point of irruption, when the roof of the level began to fall in, and he, therefore, made the best of his way with the other miners to the bottom of the shaft, and reached the surface in safety. The next gang, on entering the mine and descending to the cross level noticed above, were met by a powerful stream of water, which obstructed their farther progress, and it was therefore, evident, that the old works had been pierced, and providentially at a time when none of the men were at work in the deepest levels, who would have been otherwise placed in imminent danger of their lives; a proof of the Divine protection extended to the miner in the midst of his most dangerous labours. A superintendent, afterwards descending, found a stream of water in the cross level, proceeding at the rate of from 30 to 36 cubic feet in a second. His object was to close the entrance of the cross levels leading to the lodes, which are furnished with flood-gates; but on advancing farther on, he felt convinced that the water had overflowed these gates, and that the lowest levels and workings were filling rapidly.

Another superintendent, on feeling the coolness of the water, was of opinion that it must proceed from the river Innerst, which flows exactly over the old works; a conjecture which was subsequently confirmed by a fall of earth in the bed of the river, leaving a depression in the shape of a funnel: this led to the operation of forming a dam or embankment, after which the irruption of water materially diminished. At half-past ten o'clock, P.M., two superintendents and two miners descended for the purpose of surveying the timber-work, and of taking the necessary precautions for preventing greater damage to the works, as far as this might be practicable. Their intention was, if possible, to arrive at the point of ingress of the water, and, accordingly, they slowly advanced to within about eight fathoms of the cross-cut from which the irruption proceeded, up to their waist in water all the way. Before reaching thus far, they had observed a vapour like a fog above their heads, which farther on sunk down to the surface of the water. To this they paid little attention, thinking it to be merely the smoke from the powder recently used in the works, an idea to which its bluish colour gave rise, although, in fact, it was not of a clear blue, as in gunpowder smoke, but rather of a faint blue tinge. This vapour had now extended behind them, towards the shaft, for about eighteen or twenty fathoms along the level; when, as they were slowly proceeding, one of the party raised his light, for the purpose of taking down an oil-flask which he perceived hanging by a door-post, on which another of the men remarked, "There is that smoke again." No sooner were these words uttered, than this apparent smoke was ignited from the elevated candle, and all the persons agree in stating, that the first appearance of the flame was like forked lightning. One of the men was thrown upwards, and received a contusion on the head; the whole party was then plunged into the water, and on raising themselves again, found the whole place on fire. Immediately after the first appearance of the flame, they heard a loud crack, which seemed to proceed from the place where the fire began, and soon after they heard a sound like the former, apparently proceeding from the part of the level behind them, and prolonged like thunder, after the momentary blaze of the ignited air was extinguished. This second report was probably the mere echo of the first, which was heard by the fillers at the shaft, 250 fathoms from the spot. The situation of these four persons was now in the highest degree alarming; without lights or the means of procuring them, they were standing in the water up to their middles, and with all their clothes wet, 500 or 600 feet beneath the surface, and 250 fathoms from the shaft, through which alone they could ever hope again to see the light of day; their faces and hands were severely burnt, and they, of course, were suffering pain sufficient to deprive them of all presence of mind; but they still preserved composure enough to speak to each other immediately after the accident; the one inquiring where the gunpowder could have been, was answered by another of his fellow-sufferers, that it was not an explosion of powder, but fire-damp, most probably from the old mines, and which had been kindled by raising the candle towards the roof. They all concurred in the remark, that the loathsome odour after the explosion was more like the smell of rotten eggs, than that of gunpowder smoke.

The party now endeavoured to grope their way to the fourth cross-cut, hoping, by careful calculation of their distance and relative position, to avoid the shafts of the deeper works, and to reach the main shaft, which they at length succeeded in doing. On their progress they were gladdened with the hope of assistance, but it was only the faint glimmer of some rotten timber which they mistook for lights. On arriving at the shaft they were supplied with candles, and drawn with all possible dispatch to the surface, in a state of dreadful suffering. The appearance of the men, blackened by the fire, filled the managers and other persons who were anxiously waiting for their return with horror; means were speedily adopted for their relief, and medical aid being soon obtained, it was found, that the burns were only superficial, although the pain occasioned by them was extremely violent, and three weeks elapsed before they were able to resume their occupations.

For several days after these accidents the candles used in the mines burnt badly, being extinguished by the carbonic acid gas, if carried rather high and not carefully attended to. This was the less surprising, as in consequence of the shaft and the cross-cut being inundated, the usual ventilation was suspended. On the day after the irruption, some bottles were filled with the water, which was found very turbid with mud and small fragments of wood; on using a chemical test it showed a considerable proportion of carbonic acid. The air in several bottles filled with water and then emptied in the cross level, could not be subjected to examination; but yet it is assumable, that it was not different from the air in the mine, if we except an increased proportion of carbonic acid, for no farther traces of fire-damp were discernible, although on the day, several miners proceeded to a considerable distance in the direction of the breach, and even penetrated into a working above the level of it, whither the fire-damp, on account of its greater lightness, would doubtless have ascended. It has been already noticed, that the conjecture hazarded with respect to the irruption of water being owing to a communication between the old mines and the bed of the river, was corroborated by a depression or fall of earth near the bank; and as it appeared that, in all probability, a shaft existed in or near the river, it could no longer be doubted, that the water had penetrated into the mines from this quarter. It consequently became necessary to give the river a new direction by means of a dam, which measure had the good effect above mentioned.

It cannot be precisely ascertained, whether this communication with the old mines existed previously, or whether it took place in consequence of the sudden fall of the water through the breach made by the workmen; and it is equally uncertain, whether the old workings were filled with water nearly up to the surface, and several experiments made for the purpose of ascertaining with accuracy the line of communication, were not attended with such a result as to settle this question. However, after the river was dammed, the water ceased to trickle through the clefts in the deep levels of the George; but this affords no indication as to what height the water stood at in the old mines.

On the following Tuesday, the 13th January, several mining officers advanced as far as the breach itself, when it appeared that the bore-hole had penetrated an old working, lying nearest the slanting cross-cut, and as the water rose from the bottom of this cross-cut, and a pole several fathoms in length could be thrust into the opening without meeting any obstruction, whilst the upper part or roof was perfectly solid, it was concluded that this was in the vicinity of a shaft, or at the highest point of a working driven upwards from it. The first supposition is countenanced by the circumstance, that several pieces of hewn wood and timber-work were ejected through the aperture along with the water. It appears evident, that the water must have stood considerably higher that the point of irruption, since a door-post, about a fathom in length, of about a foot square in the solid, was broken off in the middle; and two door posts, against which, some of the boring implements were leaned, were indented by the latter to the depth of several inches. After the water had abated in the mine, it continued to trickle in very small quantities from the original breach, and the level was therefore filled with attle in order to allow of the works of the mine being continued.

From what has here been stated, the impracticability of draining the water from the old works, by means of any apparatus at the surface is sufficiently evident; and the result justifies the method employed of tapping it off from beneath.

A more correct judgment may be formed in regard to the fire-damp from the following observations, made a few weeks after the occurrence. Near the spot where the gas took fire, several pieces of the rock and particularly of the part above the level, were found to be covered with a substance similar to a spider's web, to which small drops of water adhered. On applying a candle to them they burst with the emission of sparks. This water had an acidulous taste, and on testing, was found to contain a small quantity of sulphuric acid. At the upper cross-piece of a doorway there was an indication of carbon, which seems to have been produced by the ignition of the gas, as the black mark in question had never been noticed previously.

APPLICATION OF STONE COAL TO THE SMELTING OF IRON ORE.

For some time past our columns have occasionally been occupied with suggestions as to the practicability of introducing that species of fuel called Anthracite, or Stone Coal, into more general use, and our readers are aware of the large portion of this description of coal which the South Wales mineral basin occupies. Some months ago, we were informed that our neighbour, George Crane, Esq., of the Yniscedwin Iron Works, had directed his attention to the application of stone-coal to the smelting of iron ore. From our knowledge of the indefatigable industry and perseverance with which this gentleman follows up every pursuit in which he may be engaged, we entertained a confident, and, as the result proves, a well-grounded hope that his efforts would prove successful. For many weeks past, we have been anxiously expecting a confirmation of the very favourable reports which had reached us, of the successful progress of Mr. Crane's experiments. Undaunted by the failures which had attended similar attempts, Mr. Crane, in the autumn of last year, secured a patent right, and by a method hitherto untried (viz., the application of hot blast to this fuel), he has most fully succeeded; and the peculiar adaptation of anthracite coal to the reduction of irons ore is now fully demonstrated. We were aware of the peculiar properties of anthracite coal, and that the veins with which this district abounds afford from eighty-seven to ninety-three per cent. of carbon; it did not, therefore, occasion us surprise, when we learnt that Mr. Crane anticipated that, by the successful introduction of this fuel, a description of iron would be produced, very nearly resembling in its quality that formerly obtained by the use of vegetable charcoal. In this, also, his anticipations have been fully realised, and we cordially congratulate him on the result. That most important manufacture, the iron trade, has been hitherto of necessity confined to such parts of this country where bituminous coal prevails; and a large portion of the mineral district where anthracite coal abounds, has been excluded from its advantages. Our local knowledge enables us to state, that ironstone in great abundance is found to alternate with this peculiar fuel, and the eventual effect of this most important discovery must therefore be, to induce the erection of iron-works over a large extent of country, from which this manufacture has hitherto been wholly excluded.

MICROSCOPIC FOSSIL ANIMALS IN TRIPOLI SLATE.—M. Ehrenberg has discovered that the friable silicious slate, is entirely composed of remains of Infusory animalcules of the family of Bacilariæ. These remains retain their form, so that they can be very distinctly seen with the microscope, and compared with living species. Bog iron-ore is also almost entirely composed of the species named *Gallionella Ferruginea.* If a piece of one of these substances be rubbed a little on a glass plate, and the powder thus obtained mixed with water, thousands of animalcules may be seen with a good microscope.

GLOW-WORM.—The Italian glow-worm appears to be different from ours, for, according to M. Carrarra, it has a bag or sack full of air, reaching from the mouth to the abdomen. By means of this the phosphorescent matter is put in contact with the atmosphere, without the aid of the respiratory organs. It is used at the pleasure of the insect, and causes a combustion of the phosphorus, which renders its light bright and sparkling, while that of our own glow-worm is dull and steady.

VALUE OF IRON.—The finished balance-spring of a watch affords a most striking example of the increase in value produced by labour on the raw material. The value of one ounce of pure iron may be said to be nearly inappreciable, but call it one farthing; one ounce of steel of that quality used for balance-springs is worth 4½d. This ounce of steel will yield about 950 yards of balance-spring wire, which is worth 13*l.* 4s. 2d; and this worked up into balance-springs, will furnish about 7650 springs, which, of the smallest and best kind, are worth 2s. 6d. each, amounting to 956*l.* 5s., being the increased value of the farthing's worth of iron produced by labour.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—WEDNESDAY, APRIL 19.

Rev. W. WHEWELL, President, in the chair.

A paper was read by Mr. Owen, "On the cranium of the Toxodon," a new, extinct, gigantic animal, referable by its dentition to the Rodentia, but with affinities to Pachydermata and herbiverous Cetaceæ.

This cranium forms part of the series of fossils, collected by Mr. Darwin, in South America. It was found in the Sarandis, a small tributary of the Rio Negro, about 120 miles north-west from Monte Video; and had been imbedded in the whitish, argillaceous earth, which forms the banks of that rivulet. The subsoil of the whole of the surrounding country is granitic, and Mr. Darwin considers the argillaceous covering to be an estuary deposit, accumulated by the river now called the Plata, and at a period when the land was at a lower level, with reference to the ocean, than it is at present.

The dimensions of this interesting fossil, the extreme length of the skull being two feet four inches, and the extreme breadth one foot four inches, amply attest that the species to which it belonged, attained a magnitude comparable only with some of the gigantic Pachyderms or the extinct Megatherium.

From the structure of the molar teeth, and their continuous mode of growth, Mr. Owen showed that the Toxodon is referable to the Rodentia; but that it differs from the existing animals of that order, in the number and relative position of the incisors, and in the number and direction of the curvature of the molars. The Toxodon again deviates from the true Rodentia, and resembles the Wombat, in the form of the articular cavity of the lower jaw. It differs from the Rodentia, and resembles the Pachydermata in the relative position of the glenoid cavities and zygomatic arches, and in many minor details. In the aspect of the plane of the occipital region of the skull; in the form and position of the occipital condyles; in the transverse extent of the frontal region of the skull; in the aspect of the plane of the bony aperture of the nostrils; and in the thickness and texture of the osseous parietes of the skull, the Toxodon differs from both the Rodentia and Pachydermata, and manifests an affinity to the Cetaceous order.

From these instances of aberrant characters in the Toxodon, considered as a gigantic Rodent, and which were described in admirable detail, Mr. Owen pointed out, that although the teeth from their correspondence with many other important parts of the animal structure, and from the facility of observing them, are highly important and useful zoological characters, yet that they are not in all cases sufficient alone, to determine the order to which a Mammifera belongs; and that upon due consideration it will appear, that dental characters must yield the precedence to those afforded by the modification of the organs of progressive motion. It may, therefore, be inferred, that those orders in the present, received systems of Mammalogy, which are founded on characters afforded by the teeth alone, are less natural and less important groups, than those which are based on modifications of the locomotive extremities; and *à fortiori*, on those which combine such distinctive characters, with equally characteristic peculiarities of dentation. At present there is no evidence to determine what was the nature of the extremities of the Toxodon, but Mr. Owen is of opinion, that although it cannot be positively affirmed, the genus may not be referable to the Muticata of Linnæus, yet from the development of the nasal cavity and the frontal sinus, that it is extremely improbable the habits of the species were so strictly aquatic as the entire absence of hinder extremities would occasion.

In conclusion, he pointed out the interesting fact, that the recent animal most analogous to the Toxodon, combining the characters of a Pachyderm and a Rodent, and from its aquatic habits called the Water-hog or Hydrochærus, exists only in South America—the same region in which this gigantic fossil possessing similar aberrant peculiarities has been discovered.

INSTITUTION OF CIVIL ENGINEERS.

At the first meeting of the present session,

JAMES WALKER, Esq., President, in the chair,

Lieut. Col. Pasley gave an account of the experiments which he had conducted on the manufacture of artificial cements. The strongest cement which he had made, consisted of 4lb. of chalk and 5lb. of moist clay, fresh from the Medway; with this cement he had set thirty-one bricks out for a wall, He estimated the adhesive power of this cement at about 5000lb. on the surface of the ordinary brick. As compared with old chalk mortar, he was led to consider the adhesive power of his artificial cement forty days old, at least twenty times that of chalk mortar thirty years old. At the meeting of February 14th, a paper, by Mr. Reynolds, on the construction of Railways, was read. The principles of a railway, as stated in this paper, are—1. That it should be the closest practical approximation to a perfect plane of perfect stability. 2. That it should be adapted to prevent or to neutralize the vibrations consequent on the impact of imperfect cylinders rolling on imperfect planes. 3. That it should possess the greatest durability and facility of being repaired, which are compatible with the above conditions. These objects Mr. Reynolds proposes to effect by adopting a rail, the base of which is to have a continuous bearing—that is, sustained at every point underneath, instead of at particular points, as on stone blocks. The bearing surfaces of the rail are inclined to each other at a right angle, so that the section of the rail is a triangle, with its vertex downwards. The rail is to be laid in earth beaten hard, or in such materials as can be most readily procured. By this peculiar form of the rail, Mr. Reynolds considers that the sustaining area is increased, so that a greater vertical support is procured, and the lateral stability is rendered certain. The rail consists of three parts, the trough, the wooden sill, and the rail; the trough is laid in the ground, in it is laid a sill of wood, and on this wood is placed a wrought or cast-iron rail. The wood acts as a partially elastic bed, so that the concussions which the upper surface experiences are neutralized, and the vibration almost entirely prevented. The upper rail or wood, can be readily restored if necessary; the bearer can be kept in its true place by beating earth under at the side: and the expense is estimated at about the present rails, including the blocks. To the paper are appended two reports; one by Mr. H. R. Palmer, and the other by Messrs. Grainger and Miller, on the rails of continuous bearing, but cast in one piece, which were laid down by Mr. Reynolds on Chatmoss several months ago.

GREECE.—A society of natural history has been established in Athens. It was addressed at its first meeting by M. Nicolaïdes Levadiefs, a medical officer under the Greek government. After pointing out the advantages to be derived from agriculture, of which the Greeks are now comparatively ignorant, although Sicily, a Grecian colony, was in ancient times the granary of Rome, and after adverting to Holland and England, as proofs of what skill and industry might do even with an ungrateful soil, and under comparatively rude climates, M. Levadiefs proceeded as follows:—"The Greeks formerly worked silver mines in Attica and in some of the islands in the Archipelago; but gold came to them through Macedonia and Thrace, from Pannonia and Illyria. Hence the gold coins of ancient Greece are so few, while those of the Macedonian kings are still numerous. The marble quarries of Pentelicus and Paros are too well known to need being mentioned. Chromium has been found in Eubœa; Milos is rich in sulphur, vitriol, and alum; Siphnas possesses silver ores; Naxos maintains a trade in emery; Santorin is rich in steatite, or soap-stone, which is much sought for, chiefly to make the luting of water-pipes. I shall not say anything of our numerous mineral springs, the waters of which are so serviceable to suffering humanity. Unfortunately, mines cannot be expected to repay the cost of working them, unless where coals are at hand and in abundance. It shall therefore be the business of the society of Natural History to prosecute the much desired examination, as to the nature and quality of the stone-coal discovered at Negropont and at Argos, and to report on the uses to which it may be applied, whether as fuel for domestic purposes or for the making of gas; whether it be adopted for the use of furnaces, or smithies, and for steam navigation."

SPOTS ON THE SUN.—For several weeks past a considerable number of spots have appeared on the sun's disc, some of which were very large, with a penumbral shade around them; others were much smaller, and have been in curved or circular groups, and sometimes arranged in a line nearly straight. There are at present two or three large ones near the eastern limb, and others, not so large, near the west, which may very easily be seen with a telescope of small magnifying power and a coloured glass, to prevent the strong light from injuring the eye.

PORPHYRY AND GRANITE STONES.—It is a curious fact, that the first mile of road from Shoreditch to Newington has been for some time past repaired with the black porphyry stone brought from China as ballast in the tea ships; and that the next half-mile has been repaired with granite from Bombay.

ON THE MANUFACTURE OF STEEL IN THE EAST.

At a late meeting of the Asiatic Society, the following interesting communication was brought forward, relative to the process of manufacture of the celebrated sword blades of Damascus, and the operations of making steel peculiar to oriental nations :—

"Mr. Henry Wilkinson read a paper, on the causes which produced the pattern, or watering, on the celebrated sword blades of Damascus. After alluding to the ancient renown of the Damascenes in the manufacture of swords, and the general belief that the conquest of Damascus, by Timour, in the fourteenth century, and consequent dispersion of the workmen, had caused the secret to be lost, Mr. Wilkinson observed, that, in the remote times when this celebrity was obtained, all eastern countries were greatly superior in arts to those of Europe; and that the excellency of the swords of Damascus had been much exaggerated from this cause; but that the estimation accorded to them was not warranted by our present experience, as swords of better quality might be now manufactured at a twentieth of the price. The attempts at imitation of these swords had been almost all directed to the external appearance alone; *i. e.* the watering, or *jower*, which Mr. Wilkinson considered had never been successfully produced. From several years' attention to the subject, he had reason to believe that the natives of the east were either totally ignorant of the cause of the desired appearance themselves, or that they made a mystery of that which was, in fact, none.

"Several attempts had been made in Europe, all of which had proved failures; they have improved neither the appearance nor the quality of the blades; and, in general, had done no more than produce a certain external watering, which might deceive a person unacquainted with the real sabre. From this condemnation he excepted the process of Signor Crevelli, an Italian, which was calculated to produce blades of great beauty, and equal to any ever made at Damascus; he trusted he should be able to prove that Signor Crevelli's process was not that of the Damascene manufacturers. Mr. Wilkinson here explained the process adopted by Crevelli, which consisted of a peculiar intermixture of iron and steel. He illustrated his explanation by pieces of lead and copper, bent into the required shapes. Another method had been adopted in Georgia. It consisted in twisting alternate laminæ of iron and steel, and welding them together; the process was well-known in Europe, but it produced a metal totally unfit to form the edge of any cutting instrument. A few of these were made by Goork, of Teflis, almost all of which were in the possession of kings. The one on the table had been made for the Emperor of Russia, by whom it had been presented to the late Shah of Persia; it was given by his Majesty to Colonel Hart, on whose death it was bought by Sir John Campbell, for 35*l*. In all swords of this sort, the damasked portion was simply an ornamental band, introduced near the back of the blade, being, as before observed, unfit to form a cutting edge.

"The real cause of the *jower* of the Damascus blades, Mr. Wilkinson conceived to be, first, the nature of the iron employed; and, secondly, the mode of converting it into steel. This he explained as being done by imperfect fusion and agglutination, and cementation with charcoal in small crucibles; the produce of which was a very good steel, crystallized variously, and probably mingled with minute portions of the metallic bases of the earths employed in the operation. The *jower* exists in the steel itself, and it would be impossible to make a sword of this steel, without obtaining the Damascus figure. Mr. Wilkinson had examined a cake of steel from Cutch, and found that it could be tempered without difficulty; and that it exhibited, when cut, the Damascus pattern, as it also did when forged into a bar. It was a curious coincidence, that the trade between Cutch and Damascus was formerly direct; and it was, consequently, highly probable that the Syrian workman obtained his celebrity from a mere casual circumstance, which would not have occurred if he had obtained his steel from a part of India, where the manufacture of it was conducted on a different principle. It should also be remarked, that in consequence of the small size of the cakes of steel furnished by the Indian market, three, four, or even eight cakes were required to make one sword blade. These cakes must of necessity be drawn into bars, welded together, laminated, and doubled again and again; which process would increase the intricacy of the pattern; and even the indentations of the hammer, and clumsiness of the workmen, would combine to increase its diversity. Mr. Wilkinson concluded, by observing that in these processes all the required varieties would be obtained; and that the figure of all genuine Damascus blades was the result of nature, and not of art.

"After the reading of the paper was concluded, Mr. Malcolmson stated, that he had that morning seen a piece of steel from Nirmal, a place in India, celebrated for the manufacture of that article; the greater part of the steel of that place went to Russia, and much was employed in the making of sword blades. The process of manufacturing the steel of Nirmal, was described in a paper by the late Dr. Voysey, published in the first volume of the Journal of the Asiatic Society of Bengal.

"Mr. Wilkinson observed, that he had no doubt that other Indian manufacturers produced steel of a similar quality to that he had been describing. He also said, that he had seen at the East India House, a manuscript, he believed of the late Mr. Moorcroft, describing a mode of bringing out the pattern on the steel, without the use of acids. It consisted in suspending the polished metal in a well, about six feet deep, and funnel-shaped, at the bottom of which was placed a quantity of warm litter: the acrid vapour arising from the dung brought out the damask in the course of a few weeks, without any of the disadvantages attending the use of acids."

The following paragraph has since appeared, correcting a mis-statement in the report we have quoted above :—

"In our last report of the meetings of the Royal Asiatic Society, some observations, made by Mr. Wilkinson at that meeting, appear to have been mis-stated. It was there stated, that the Indians had a mode of bringing out the pattern on the damasked steel, by means of the vapour of horse-dung; whereas it appears to be, that the damask is elicited on their gun-barrels by covering them with a paste of sulphate of lime and water, and then suspending them in a well, as described in our paper. The agency of the vapour alluded to is confined to the excluding of the atmospheric air, and thereby preventing the corrosion of the metal by oxydation."

PLUMBAGO AND BLACK LEAD PENCILS.

There is only one purpose to which this form of carbon is applied in the solid state, viz., for the manufacture of black lead pencils, and its adaption to this end depends on its softness. In the state of a powder, plumbago is used to relieve friction. Its power in this way may be illustrated by rubbing a button first on a plain board, five or six times, and applying it to a bit of phosphorus, the latter will immediately burn. When rubbed on a surface covered with plumbago, double or triple the friction will be required to produce the same effect. One of the most remarkable circumstances connected with plumbago, is the mode in which it is sold. Once a year the mine at Borrowdale is opened, and a sufficient quantity of plumbago is extracted, to supply the market during the ensuing year. It is then closed up, and the product is carried in small fragments of about three or four inches long, to London, where it is exposed to sale, at the black lead market, which is held on the first Monday of every month, at a public-house, in Essex-street, Strand. The buyers, who amount to about seven or eight, examine every piece with a sharp instrument, to ascertain its hardness—those which are too soft being rejected. The individual who has the first choice pays 45s. per pound, the others 30s. But as there is no addition made to the first quantity in the market, during the course of the year, the residual portions are examined over and over again, until they are exhausted. The annual amount of sale is about 3000*l*. There are three kinds of pencils, common, ever-pointed, and plummets. The latter are composed of one-third sulphuret of antimony, and two-thirds plumbago. The first part of the process is sawing out the cedar into long planks, and then into what are technically termed tops and bottoms. The second, sawing out the grooves by means of a flywheel. The third, scraping the lead on a stone, having been previously made into thin slices, to suit the groove: introducing it into the groove, and scratching the side with a sharp-pointed instrument, so as to break it off exactly above the groove. The fourth, glueing the tops and bottoms together, and turning the cedar cases in a gauge. The *ever-pointed* pencils are first cut into thin slabs, then into square pieces, by means of a steel gauge. They are then passed through three small holes, armed with rubies, which last about three or four days. Steel does not last above as many hours. Six of these ever-pointed pencils may be had for 2s. 6d. If they are cheaper than this, we may be sure that they are adulterated. In Paris, when you buy a sheet of paper in a stationer's shop, some of these pencils are added to the purchase. Now, these are formed of a mixture of plumbago, fuller's earth, and vermicelli. Genuine cedar pencils must cost 6d. each. If they are sold at a lower price, they must be formed from a mixture, not from pure plumbago. Pencils are, however, sold as low as 4½d. a dozen. There is no patent which has been more infringed on than that of Mordan's, for ever-pointed pencils. Birmingham is the source of this infringement, where they are sold as low as ½d. each, formed of composition. A thousand persons are now engaged in the manufacture of these pencils and pencil-cases. These facts were stated by Dr. Faraday, at the Royal Institution, April 22.—*Arcana of Science.*

MINERAL RESOURCES OF BELGIUM.

The following is extracted from the "Almanack Belge," a publication containing much useful statistical information, and affords the best summary we have yet seen of the mineral resources of that country :—

"Belgium possesses beds of coal and iron mines, more valuable than the silver veins of Peru, or the gold of Brazil. The coal-beds of Belgium are superior to any on the European continent. In the basin of Mons, for instance, we find from a hundred and ten to a hundred and twenty strata, or layers of coal, disposed one above another, all workable, and all wrought. The four principal collieries of Mons, Marimont, Liege, and Charleroi, yield annually 3,200,000 tons of coal. The whole produce of the French coal-pits, in 1834, did not exceed 2,500,000 tons. Nor is Belgic industry less striking as regards iron than it is with respect to coal. It is remarkable, and somewhat inexplicable, that, to this day, no attempt for the fabrication of iron after the English fashion—that is, by extracting it from the iron-stone or ore (by means of coal or coke)—has succeeded in France, though many districts abound in natural advantages for the purpose. In Belgium, on the contrary, the undertaking has been accompanied with the most marked success. Seven years ago (in 1830), some capitalists at Charleroi erected a furnace, where they treated the mineral of the district with the coal which likewise exists there. On the first trial, an article was produced which was greedily bought up by the Parisian iron-founders. From that time till this, establishment has followed establishment so rapidly, that, in the district of Charleroi alone, there are, at this day, twenty-five coke-furnaces in action, producing annually 75,000 tons of metal, without reckoning furnaces where wood is employed. In 1834, the iron produce of all France, from the combustible mineral as in Belgium, amounted only to 47,000 tons; the French castings in the same year, of every kind, amounted in whole to 269,000 tons. So rich in iron and coal, Belgium could not fail to have flourishing manufactures; the woollen stuffs of Verviers, and the flaxen goods of Flanders, are familiar to the world.

"It is known that the French manufacturers of linen, woollen, and other soft goods, have declared the impossibility of competing with the manufacturers of Verviers and Ghent, on account of the greater excellence and abundance of the landed produce, lint, flax, &c. of Belgium; and it is also known, that the iron-workers of France have expressed similiar opinions, on the ground of the greater fertility of Belgium in coal. Thousands of French operatives, it is said, have been reduced to beggary from these causes. These remarks are confirmed by the conduct of the French government, which, in consequence of the national inferiority in these respects, has judged it impolitic to unite France and Belgium by the strong bond of a commercial association. By this conduct, however, a chance has been left of the accession of Belgium in self-defence to the Prussian commercial league, which is decidedly hostile in its tendency to the interests of France.

"The Belgians follow out their manufacturing and mining pursuits with a boldness and energy most honourable to the national character. Six hundred feet was not long ago reckoned an extraordinary depth to push a mine down into the earth; recently, the Belgian miners have penetrated above thirteen hundred feet; they wrestle fearlessly with subterranean torrents, and with steam-engines raise their waters from their hidden sources. With the lamp of Davy, they defy the treacherous air-damp, which has involved so many in instantaneous destruction. Not less active and industrious are those among the labouring classes of Belgium, whose lot it is to toil in the eye of day.

"While the French are building senseless monuments, the Belgians are busily raising structures for manufacturing industry, such as fabrics for the reception of furnaces, plating or boring machines, or forges. One capitalist of Belgium has been known to erect, for the convenience of his own individual business, more buildings than the French artillery destroyed at Antwerp. The establishment of Seraing, near Liege, extends, in regular buildings, for a quarter of a league (three quarters of an English mile). On the side opposite the Meuse are situated the mines, from which issue the mountains of coal, to be converted into coke. Next to these are the great round towers, sixty feet high, and fortified with iron, from the mouths of which flames are continually darted as from a crater. One of these furnaces has been in action for six years, and during that time there have been thrown into it, each day, nearly one hundred thousand killogrammes of materials. The numerous other buildings attached to this establishment are filled with steam-engines, forges, refining places, &c. Almost ere the manufactured iron be cold, it is delivered over to expert artisans, well provided with every species of instrument, who make from it machines and tools of all possible kinds, and, above all, rails for railways, which may be regarded as a sort of steam-horses, surpassing all the Arabian barbs that ever cropped the scanty herbage of the desert. The whole neighbourhood of this establishment is traversed by railroads and canals. The workmen at Seraing are three thousand in number.

"The boldness of modern industry, and the colossal range of its operations, exact, on the part of the men who direct these, an expansion of views and a rapidity of comprehension and decision similar to what is required in a general; and, not unfrequently, to carry the parallel farther, a degree of courage is demanded on the part of the workmen similar to that which has often ennobled the common business of the soldier. We allude to the occasional bursting of furnaces and other accidents liable to occur both above ground and in the mines, at which times a degree of intrepidity and nobleness of spirit has been repeatedly evinced by common workmen, surpassing, from the superiority of the object in view, all the exploits that were ever performed in the 'imminent deadly breach' of war. Many instances of this kind might be related of the workmen of Belgium.

"A nation, cultivating industrious pursuits with so much sagacity and intelligence, so completely absorbed, in fact, in active business, might be expected to avail themselves with ardour of the prospects recently opened up by railroads. On the 1st of May, 1834, a law to the following effect was promulgated bythe Belgian government :—

"'Article 1. There shall be established a system or chain of railways, having Malines for a centre point, and stretching to the eastward toward the Prussian frontier by Louvain, Liege, and Verviers—to the north as far as Antwerp—to the west as far as Ostend, by Termond, Ghent, and Bruges—and to the south by Brussels, and towards the frontiers of France through Hainault.

"'2. The railways shall be executed at the public charge, and under the direction of the Government.'

"Thus, while France is resting in shameful inactivity, in accordance with the ridiculous principle, that it is not proper for a Government to interfere with the course of national industry, the little kingdom of Belgium is marching straightforward in the path of prosperity, without embarrassing itself with any prejudicial question of the sort—this line of railroads, crossing to all the cardinal points of the compass, being at this hour in the course of execution. The line from Antwerp to Brussels is completed, and has been travelled for several months. The revenue derived from it has exceeded the highest expectations. With the exception of the line from Brussels to the French frontier, the construction of which must depend on an understanding between the the two countries, the whole of the projected Belgian railways will be completed within two years. It is supposed the eastern, western, and northern lines, the aggregate length of which is 222 English miles, will be finished at an expense of forty-five millions of francs (1,875,000*l*. sterling). The proportionate expense per mile, must, of course, vary according to the difficulties or facilities of the ground. That portion of the line which extends between Brussels and Antwerp, a distance of thirty-three miles, passes over ground naturally level, and cost 4350*l*. a mile. More inaccessible districts will cost much more than this, as has been said; but it may be questioned whether any part of the Belgian railways will approach near to the expense of the line between Paris and St. Germains, which is estimated at above 24,000*l*. sterling per mile. The abundance of iron in Belgium, will render all public works of this kind comparatively cheap.

"In addition to the 222 miles of railway first projected, nearly 100 miles additional have been subsequently resolved upon, in order to perfect the internal intercourse of the country. When these plans are all completed, the industry of the people will then have every facility in their way that art can afford them; and, as they possess immense internal resources, instead of being a plaything in the hands of every nation that may choose to go to war, Belgium must become a rich and important state. That its inhabitants will also be amongst the happiest on earth, may also be pronounced, from the attention which they pay to that inestimable and indispensable possession—education."

OXIDULOUS COPPER.—Mr. G. Sowerby, in *Loudon's Magazine* for March, gives an account of the occurrence of detached cubes of this mineral in Cornwall. They vary in dimensions from a quarter to nearly three quarters of an inch: they are of a very dark colour: many of them are nearly complete at all their angles, more particularly the smaller ones. Occasionally two or three are grouped together; some of them are accompanied by a small quantity of green carbonate of copper. Very few are slightly modified, having some of the planes which tend to the rhombic dodecahedron; and one very large crystal, being exactly half an inch long, which is adhering to a like quality, has the planes of the octohedron as its solid angles.

ANIMALCULÆ.—In the last published part of the new edition of the "Encyclopædia Britannica," under the article microscope, by Sir David Brewster, we have the astounding information that "the size of a single individual of the animalculæ lately discovered in silicious rocks is 1-288th of a line, or 1-3456th of an inch. In the polishing slate from Bilin, in which there appear to be no vacuities, a cubic line contains, in round numbers, 23,000,000 of these animals, and a cubic inch contains 41,000 millions of them! The weight of a cubic inch of the polishing slate is 270 grains. There are, therefore, 187 millions of these animals in a single grain, or the silicious coat of one of these animals weighs the 187-millionth part of a grain."

RECENT DISCOVERY IN AUSTRALIA.

EXTRACT OF A LETTER FROM LAUNCESTON, VAN DIEMAN'S LAND.

[From a Correspondent,]

* * * Edward has been away from Launceston about two years, and will remain here now no longer than he can help, as our affairs at Portland Bay begin to assume importance—John and Frank are managing them for the present. Our stock there consists of 120 heads of cattle, four horses, 1500 sheep, and the usual *et ceteras* of a large settler's establishment. We have now purchased between 2000 and 3000 ewes, which we intend to send down there this summer, from which we soon hope to form a large flock, and a paying export. Major Mitchell, the Surveyor-general, has been on an exploring expedition, into the interior of New South Wales, for the last six months. His first object was to trace down the Darling, which he did to the Murray, thus confirming Sturt's supposition, that it was the Darling he saw on his expedition to Lake Alexandria. Major Mitchell's next object was, to take an accurate survey of the south country, near the Morrison, extending only to 141 degrees, lay down the headlands along the coast, and return to Sydney. On the 29th of August, judge of Edward's surprise at Portland Bay, to see nine men on horseback come down through the bush towards the house. He concluded they were runaways from Sydney, but Major Mitchell rode up, and a mutual and very satisfactory explanation took place, equally gratifying to both parties. The major was astonished at the civilization and improvement he saw, and left the next day very much pleased, first confirming all the local names which we had given in the neighbourhood. The major's party consisted of twenty-three convict servants, an assistant surveyor, and himself, with sixty bullocks, twelve drays, sixty-two sheep, and ten or twelve horses. He had been absent six months, and he has driven sheep the whole time, for previously he had only two bullocks. He describes the country south of the Murrambidgee, to be by far the finest he ever saw in Australia—one uninterrupted pastoral district, and which he has named "Australia Felix." It is one of the greatest discoveries yet made in these countries, and opens an immense field for future speculation and enterprise. Major M. returns to England, and will publish his book immediately, when, of course, you will see it. I have left myself only space to say, that we are all well, and, by the blessing of God, have every prospect of succeeding to our utmost expectations.

REMARKABLE DISCOVERY.

It is well known to our readers, that among the many natural curiosities found in the extensive caves and grottoes in the vicinity of the Great Laurel Ridge (Cumberland mountains), many human skeletons and bones of animals have been discovered, some of them in a petrified state. These caves abound in prodigious vaulted apartments and chambers, which, when viewed by torch-light, exhibit scenes of gloomy grandeur, which astonish the beholder. Several petrified trees have also been discovered on the banks of the river near this ridge, as also bones of mammoths, and other animals whose races are now extinct.

But the most remarkable discovery that has ever been made in this part of the country—if not the greatest natural curiosity in the world, was brought to light on Sunday, 24th January, by two scientific gentlemen, with whom we are acquainted, and who are now in town. They have been for several weeks exploring the caves above alluded to, and gathering such curiosities as they wished to carry away with them.

They are provided, for this purpose, with a boat of gum elastic, and capable of buoying two persons. With this boat, and other conveniences procured for the purpose, they will, undoubtedly, before they leave their task, penetrate every accessible hole in the West Cumberland mountains—for they are determined to spend the whole season among them.

The wonderful discovery, which will now shortly be presented to the public, is *three petrified bodies entire*, one of a dog, and two human bodies, one of them holding a spear. It is believed by these gentlemen that all three of the bodies may be removed from their position in a perfect state; though the dog, being in a lying posture, upon a flat rock, it will, undoubtedly, be a difficult task to remove it uninjured. The human bodies appear to be those of men—probably hunters. Their clothing can hardly be distinguished, but still it is evident that that, too, was, in a measure, turned into stone. They are described thus—one sitting, with the head leaned, as it were, against a projecting rock, and the other standing, with a spear balanced in his hand, as though he was surprised, and had just started on a quick walk. The dog lies as if crouched in terror, or about to make a spring; but the features, or body, is not distinct enough to determine which position.

This wonderful formation cannot be accounted for in any other way than that these persons were buried by some terrible convulsion of nature. The cave in which they were found is full 125 feet into the mountain, and is situated about a mile and a half beyond what is called Mammoth Grotto, in a direct line. The entrance to the place is difficult, and it is thought that it was never before attempted at all. At the foot of the entrance of the cave is a considerable brook of water, which appears to gather from all parts of it. There is also a valley thence to the river. The gentlemen who have made this interesting discovery are making active preparations to bring away the bodies, which they intend to have forwarded to New York.

Since the above was written, we have had an invitation to visit the cave and bodies, which we shall most certainly accept. We have hitherto declined to mention the names of the persons to whom we have alluded in this account. One of them is a wealthy English gentleman, a resident of Philadelphia, John Chester, Esq., and his companion is Mr. Jacob L. Davis, a Philadelphian. The object of their scientific researches is principally their own gratification.—*Hamilton* (Tenn.) *Observer.*

INDIAN WELL-SINKING IN SANDY SOILS.—The country all around Saharunpore is highly fertile, though here, as in the vicinity of Deobund, the agriculture is sadly impeded by an insufficient irrigation. I had no intelligent *jemmadar* to furnish me with the precise number of wells, or the speculations of the husbandman, as upon a former occasion; but I had an opportunity of inspecting the method of constructing wells, adopted by the natives, which appeared to me an excellent and ingenious plan. The soil being very loose and sandy, renders abortive all attempts to sink a shaft in the usual way—the excavation being re-filled with the falling earth as fast as the labour proceeds. To obviate this impediment, the natives have recourse to an expedient, which is thoroughly successful. Upon the intended site of the well, before they commence the process of boring, the workmen build up circular walls of solid masonry, of the dimensions proposed for the work; this is carried to a certain height, in proportion to the breadth and weight of the material, and then the operation of digging commences within the cylinder; the masonry being allowed to sink gradually into the earth as the soil is removed. As the column disappears below the surface, the masons continue to build upon it; great care being taken to preserve the perpendicular, and to keep the superincumbent weight above equal to the increasing resistance.—*Lieut. Bacon's Hindostan.*

PALEONTOLOGY.—An interesting discovery has been made in the south of France. While representatives of nearly all the living species of mammalia have been found in the fossil state, it has excited surprise that not a single bone has been met with belonging to the *quadrumana*, or monkey tribe, which is now so numerous. At length, however, a fossil jaw-bone of this species has been discovered in the tertiary formation at the northern foot of the Pyrenees, in the department of Gers. Two deposits here are very rich in fossils, affording remains of no less than thirty mammiferous animals. In the second and newer of these, which is lacustrine, the jaw-bone of the monkey was found; and the same group contained three species of rhinoceros, a palætoeriom, a large anoplotherium, another small pachydermatous animal, three species of deer, two antelopes, a gigantic carnivorous animal, a true dog, a large cat, an animal like a weazel, a small hare, and a very large Edentate quadruped. The jaw-bone alluded to contained four incisor teeth, two canine, four false grinders, and six true grinders, in a continuous series. The monkey is supposed to have been about three feet in height. The bone occurred in a stratum of marl covered by compact limestone.

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The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT---XVII.

REVIEWS.

Transactions of the Institution of Civil Engineers. Vol. I. Weale, London. 1836.

[*Concluded from page 62.*]

In concluding our notice of this valuable and interesting work, we shall direct attention, as on a former occasion, more particularly to those papers which treat on subjects coming immediately within the province of our publication—those which have reference to subterranean operations, and to the various productions which we derive from the bowels of the earth, whether by the operations of quarrying, of mining, or otherwise. With these views, the papers which relate to boring operations will now claim our attention.

A copious supply of pure water, for domestic purposes, is a requisite of the first necessity, wherever man has fixed his abode, and more especially in those great and crowded cities which result from a high degree of civilization, and a consequently complex state of society. The supply of this element, essential alike to man, the inferior creation, and the vegetable kingdom, has formed a beautiful feature in the grand economy of Nature, furnishing one of those striking proofs of design and adaptation, so obvious as to address themselves to the meanest understanding, and yet, perhaps, too frequently disregarded from that very cause. The constant evaporation which takes place from the surface of the globe, and more especially from the expanse of water which spreads over three-fourths of that surface, supplies the atmosphere with those enormous masses of vapour, which rise into its upper regions in the form of clouds; and by causes, not yet, perhaps, wholly understood, are again distributed over the face of the earth in abundant and fertilizing showers. The mere reciprocation of water between the earth and the atmosphere, arising from evaporation and meteorological agency, forms, however, but a portion of the arrangements to which we have alluded—the clouds would in vain "consign their treasures to the field," were it not that the surface of the earth has itself been beautifully formed and moulded by its Creator, both to collect and to distribute, the element it thus receives. The hills and mountains which spread over so large a portion of our continents and islands, give rise to a curious system of larger and smaller vallies, whose ramifications penetrate in all directions, and afford channels for the rivers and streams which traverse and irrigate almost every portion of the land, at comparatively trifling intervals, thus affording that abundant and almost universal supply of water, without which the earth would be scarcely habitable either by man or the animal creation.

The proximity of rivers, and the consequent fertility of the adjoining vallies, appears to have been one of the principal causes which influenced the early settlements of mankind, and the scites of the most ancient cities, even at periods when the contingent advantages of navigation were, in all probability, but little appreciated or understood.

The Egyptian empire—the cradle of civilization, of art, and science, was founded in the narrow valley watered and fertilized by the Nile; Rome was built on the banks of the Tiber; and the great rivers of the Indian continent, have not only concentrated the population in their vicinity, but have been regarded, from the remotest periods, with the most religious veneration. On the continent of Europe we shall indeed find scarcely a capital, the situation of which has not been determined by the proximity of a river or an estuary.

Our business on the present occasion is chiefly, however, with those less obvious arrangements, by which Nature has regulated the distribution of "the waters under the earth"—of those subterranean reservoirs to which the ingenuity of man has taught him to have recourse, where the usual supply is not to be obtained at the surface, either in the purity or abundance which is requisite to his wants

On a former occasion, in our notice of Dr. Buckland's "Bridgewater Treatise," we have briefly glanced at this subject, and pointed out the mode in which the interior of the earth has been adapted to afford channels and receptacles for subterranean waters, thus affording copious supplies in situations where it does not exist at the surface. In our "Foreign Extracts," the geological structure of those tracts of country which are adapted for the formation of Artesian wells, and the circumstances which regulate the supply of water thus obtained, have been treated on at considerable length, and the volume before us contains much sound and valuable information on the subject, a portion of which we shall now lay before our readers.

The first and most interesting paper of the kind is by Mr. John Seaward, "on procuring supplies of water for cities and towns by boring." The generally-received opinions on this subject, among those who have not given it especial attention, are, we believe, both imperfect and erroneous, and as such opinions have often led to great and fruitless expense, we shall devote some space to its consideration.

It is certain, that by the operation of boring, in very numerous instances, copious supplies of excellent water have been obtained, at a comparatively small expense, and with the additional advantage, in many cases, of rising to the surface, or even flowing over as a natural fountain—facts which have been proved by works of this kind not only in England, more especially the vicinity of London, but also, in perhaps a still more remarkable degree, in various parts of the continent.

Notwithstanding the advantages here mentioned, there are several circumstances which should be kept in mind whenever it is proposed to obtain a supply of water by the operation of boring—of these the most important is the geological structure of the country, which may be either highly favourable to this operation, or, on the contrary, of such a nature as to afford only the most remote probability of success. The quantity of water required is also an important consideration, as although very copious supplies have been thus obtained, it appears certain that the quantity is, in most cases, totally inadequate for very extensive uses, as, for instance, the supply of a large town. Attention should also be paid to the influence which the proposed boring may be expected to have upon similar works in the vicinity; for, although the subterranean reservoir may furnish an abundant supply to one source of this kind, the quantity of water may be materially diminished when divided between two.

We shall now proceed to Mr. Seaward's paper, and, concurring as we do, in a great measure, with the views which he expresses, and believing that the information contained will be generally useful and interesting to our readers, we shall extract the whole article, as it is only of a very moderate length:—

"A French gentleman of our acquaintance having recently addressed us upon a project of supplying the different towns of France with water, by means of boring in the earth, according to the method which has come lately a good deal into fashion in different parts of England, and thus having brought the subject under our mature deliberation, we offer the following remarks, which we were led to give in reply, with the hope that they may be found not altogether uninteresting to the institution.

"In the first place, as respects the project of furnishing water to the different towns of France, by means of simply boring in the earth; if by this is intended that the various towns are to be supplied with water economically, for all domestic and manufacturing purposes, in the same abundant manner that it is furnished to the inhabitants of London, and other towns of England, we must at once declare, without any hesitation, that, as a general principle, the scheme will be abortive, and if attempted, will infallibly end in loss and disappointment.

"In stating thus explicitly our opinion, we do not wish to be understood as being anywise unfavourable to boring generally; on the contrary, as an art, when employed under suitable circumstances, we know that it can be made, on various occasions, highly subservient to the wants of man, but we also know that, with many persons, a very erroneous opinion prevails as to the economy, and other merits and advantages of the art.

"The method of 'simple boring,' as it is called, is not adapted for all situations and places; it requires a combination of circumstances not generally met with: London, and the surrounding district, wherein this art has been most successfully practised, is highly favoured in this particular; the stratum of soil is a bed of clay, varying from 100 to 200 feet thick, and is, therefore, very easily bored through. It is remarkable, that the springs under the bed of clay produce the finest and most salubrious water, while those above the bed of clay, produce water so impure as to be unfit even for the most ordinary purposes. It is, therefore, easy to conceive, that this method would here meet with the most favourable encouragement, but in districts where the same circumstances do not exist, there would not be the same inducement to follow it.

"'Simple boring' is suitable only when the quantity of water required is comparatively small: thus, if the object be to furnish a very superior water for a nobleman's mansion, for a small village or neighbourhood, or even for a single manufactory, then this method is admirable, provided the circumstances are in any proportion as favourable as in the district which surrounds London; but if the question be to provide an abundant supply of water for a large town or populous city, then certainly in every case, the method of boring should, on the score of economy, be the last that ought to be resorted to for that purpose.

"That the bowels of the earth contain springs of water in abundance, there can be no doubt; miners and colliers are aware of this fact to their cost and sorrow: but we know full well, that those same springs, if they have sufficient natural force, must find their way to the surface of the earth somewhere, without any boring, and then form rivers and flowing brooks. Why then delve a great depth, at an infinite expense, to procure that which we can generally obtain so readily and economically on the surface of the earth?

"There is scarcely a city or town of any magnitude but what has some fine river or copious brooks in its immediate neighbourhood; these are the natural sources whence we should obtain our supply of water; but if the streams in the vicinity are so impregnated with deleterious matter, as to render the water unfit for domestic or manufacturing purposes, and if no ready method can be adopted for cleansing it, recourse should then be had to the water that falls from the heavens; tanks and reservoirs (similar to those employed in feeding navigable canals) should be formed in convenient situations, to receive the rain-water which falls on the adjacent hills: either of these means would furnish an abundant supply of this necessary element constantly and economically.

"It is perfectly true, that a populous town may be so situated as to be at an inconvenient distance from any salubrious river or brook, whence to obtain water, and local circumstances may be such as to render it impossible, or inexpedient, to form in the vicinity tanks or reservoirs to collect the rain-water from the hills; in this case, there appears to be no alternative but that of obtaining a supply from the bowels of the earth; in such case, it will be necessary to sink very capacious wells or shafts to a great depth, with suitable pumps and steam-engines, to bring the water to the surface; and, even then, the supply may be so scanty, as to render it necessary to drive (in various directions) horizontal levels or galleries from the bottom of the wells or shafts, in order to break in upon the springs which may exist at a distance; similar to the method practised in the salt-works of England, to obtain a copious supply of the brine; but in such case to expect that by simply boring down into the earth, a plentiful supply of water can be obtained for the domestic and manufacturing purposes of a populous town, is to expect what rarely or never can be accomplished.

"The modern plan of boring to obtain water has been, without any rational grounds, cried up as a new and wonderful discovery, but the truth is, that boring is an operation of great antiquity; the miner and collier make use of it in a variety of ways, and it has from time immemorial been a useful auxiliary to the well-digger; he employs this process to discover where springs of water exist. By this means he can at a comparatively small expense determine whether the situation is favourable or not for forming a well; at the same time he can ascertain the quality of the water when obtained, and the probable ultimate expense which must be incurred in order to secure a regular supply.

"In some instances it has happened that in boring, from the cause just stated, the water has of its own natural force risen up through the hole, and flowed over the surface in considerable quantity, and thus, without much further trouble or expense, a tolerably copious supply has been obtained. This circumstance it is that has brought into favour the idea of depending on simple boring alone, as a regular systematic method of obtaining a supply of water; and it is but right to say, that the method, in many instances, has been remarkably successful; but it should be borne in mind, that the supply, copious as it is called, has scarcely in any one instance exceeded what would be required for a moderately extensive manufactory, or for the domestic use of a very small village; moreover, although considerable success has attended many of the experiments made to obtain water in this way, yet it is most certain that, as regards the obtaining of an abundant supply by the simple process of boring alone, in a majority of cases, the method has *completely failed*; and, after a very heavy and useless expense and loss of time has been incurred in these failures, recourse has at length been had, either *partially* or *wholly*, to sinking a well.

"The most rational plan for obtaining a good supply of water from underground is, in the first place to sink a well to about half the depth at which it is supposed the spring of water exists: thus, if the spring is judged to be 100 yards below the surface, then the well may be made fifty yards deep; this being properly built up and secured, the engine erected, and suitable pumps fixed, the remainder of the depth to the spring may be pierced through by the process of boring, and in this way a copious supply of water is frequently obtained, and as may be readily judged, the quantity of water obtained will vary according to the greater or less depth to which the well is formed; but at the same time it should be observed, that the deeper the well, the greater will be the expense of raising the water to the surface.

"If necessary we could here enumerate a long list of losses, failures, and consequent disappointments, which have attended the process of boring, within our own observation; for the present, however, we shall confine ourselves to two instances.

"About four years ago we erected, almost in the heart of the metropolis, a fourteen-horse condensing engine for a manufacturing purpose. As a good supply of water was wanted for that and other objects, the proprietor of the establishment thought he would obtain this necessary element on his own premises, and make himself independent of the water-companies. We recommended him to sink a well at once; but contrary to our advice, he determined to try the process of simple boring, the situation of his premises being judged very favourable for that purpose. A hole was consequently bored to about 100 yards deep, and after some labour and expense water was obtained, but the supply was so scanty as not to be half sufficient for the fourteen-horse engine; several attempts were made to remedy this but without effect; the hole was at length abandoned, and a well was then formed, though not so deep as it should have been; boring was then resumed to the depth of what was considered the main spring; pumps were put down the well and water was again obtained; but even after all, the supply was barely sufficient for the engine. The result of this business was, that the proprietor after having his premises in confusion for nearly two years, in the end expended double as much money as would at once have formed a good productive well, and the interest of the money so expended is considerably more than he would have had to pay to any water-company for all the water he required for his engine and manufactory, besides losing a considerable portion of the power of his engine, which is expended in drawing the water to the surface.

"Within a quarter of a mile of the above-described well was situated a brewery, furnished with a similarly-constructed well, from which a considerable supply of water had previously been obtained; it is, however, worthy of remark, that no sooner did our engine commence drawing water from the new-formed well, than the brewers immediately lost a great part of the supply they had previously been accustomed to derive from theirs; the consequence was, they were under the necessity of sinking it deeper, and of putting up more powerful pumps, in order to obtain their former supply.

"We mention the above fact to show that, although there is no question but it is possible to find a spring of water in almost any situation, yet the springs do not furnish that inexhaustible supply of water which some persons imagine; indeed a bare consideration of what is accomplished in mines and collieries must convince us of the truth of this fact; were the springs of that inexhaustible nature some pretend, not a single mine or colliery in the universe could be workêd to any moderate extent whatever.

"The second instance of failure in boring, which has happened in our own practice, we shall now proceed to relate. About twenty years ago, a canal was cut in the neighbourhood of London, which passes over a very hilly tract of land, and in the summer months there is great difficulty in obtaining a sufficient supply of water for the upper level. It is true, the canal passes very near some copious brooks and streams, which, with little expense or trouble, might have been made available to supply every deficiency twenty times over; but, from some circumstances, the proprietors of the canal were not permitted to take advantage of these facilities, and as the rain water they were enabled to collect from the hills was inadequate, they were under the necessity of resorting to the bowels of the earth to supply the deficiency. For this purpose, a large hole was bored down at the side of the canal, to a depth of two or three hundred feet, to what was understood to be the main spring: the water speedily rose, and flowed over the surface. However, it was soon discovered, that the quantity obtained by this means was so very small as to be of no practical utility. A well of large dimensions was then sunk down about eighty feet, the boring still continuing to the original depth; pumps were fixed, and machinery worked by horses; the supply of water by this means was increased ten fold, but still was inadequate for the purpose required. We were then employed to erect a steam-engine, with suitable pumps, &c., and the well was sunk to double the original depth; a much more copious supply was now obtained, and the navigation thereby greatly assisted; but, after all, the expenses attending these works, and the pumping up the water from such a depth, and that too still inadequate in quantity, are evils of such a serious magnitude, that these, joined to other circumstances attending this property, will probably, before long, cause the whole of the concern to be abandoned.

"We could add many other instances of the total failure of what is called the simple boring system; of works begun and never finished to any useful purpose; of others pertinaciously carried on for four or five years, until the patience and the funds of the parties were alike exhausted; but we think enough has been stated above to prove to your satisfaction, how very uncertain has been this method of obtaining water. We think it right, however, to guard against the impression that boring for water is a bad system; on the contrary, allow us to repeat that we think most highly of it; but then only under proper management, and as a useful auxiliary to the sinking of capacious wells.

"With respect to the project generally, of forming a regular establishment for the purpose of supplying water to the various towns of France, we have to remark, that there can exist no physical impediment to the accomplishment of the plan; there is no question but every town in France might be made to enjoy the same inestimable advantages possessed by the inhabitants of London and other towns of England; that is to say, a constant, abundant, and economical supply of good water, for all purposes of domestic and manufacturing use; but of the three modes by which this can be accomplished, the one by boring or well-sinking is decidedly the most expensive, and the most uncertain in the final results."

Concurring, as we do, in the sound and rational views contained in this paper, we must express some doubts whether there are yet sufficient grounds for considering that the supply of water to be obtained in the vicinity of London by boring, is quite so limited as it is here considered. The great subterranean reservoir in the neighbourhood of the metropolis, and beneath the London clay, is well known to be the upper beds of the plastic clay formation, and on reaching these our wells and borings are usually suspended. The plastic clay is, however, of considerable thickness—often, perhaps, two hundred feet—and we may, therefore, reasonably suppose, that the lower beds which are not penetrated into contain a considerable store of water, and that the quantity obtained might consequently be much increased, were the upper springs to be stopped back, and the perforations continued to a greater depth.

An "account of several sections through the plastic clay formation in the vicinity of London," is furnished by Mr. William Gravatt, and contains the result of several sinkings and borings. In this paper the following curious circumstance is mentioned:—

"A pipe, sunk by Mr. Turner, ninety-five feet deep, near Bermondsey new church:—when they reached eighty feet, the rod sunk down fifteen feet at once; after pumping out several tons of green mud, the water rose to within twenty-five feet of the top: it rises and falls about three feet with the tide; the water is quiteclear, and tasteless. At a place not 500 yards from this, they sunk a pipe 190 feet, with very little success, the water being out of reach of a pump, and appearing bad."

A short paper, by Mr. John Donkin, is of a similar nature to the preceding, containing "some account of borings for water in London and its vicinity." This paper we shall here extract entire, as it is too short to render abbreviation necessary:—

"*Particulars of a Well sunk at the Excise Office in Broad-street, London.*—In the first place, after excavating the upper stratum of gravel and loose soil, four cast-iron curbs were sunk, each six feet long; the lowest of these entered the clay about three feet; the digging was then continued through the clay to the depth of 140 feet, and a curb of brickwork within the iron curb was sunk the whole depth in the ordinary way, the iron curb serving merely to support the upper stratum, and to prevent the land water getting into the well. Boring was then resorted to, to the depth of about twenty feet, when the water appeared, and rose to within sixty feet of the top of the well; a copper pipe was then driven through the last-mentioned twenty feet, to keep the passage open for the supply.

"*Wells sunk at Messrs. Brandram's Vitrol and White Lead Works, Lower-*

road, Deptford.—The wood and brick curbing was sunk barely thirty feet; the bricks were laid in Roman cement to keep out the water from the land springs; the well was then bored to the depth of about 180 feet into a bed of chalk, from which the soft water rises and flows to within nine feet of the top of the well, through wroughtiron tubes riveted together. The strata are chiefly composed of yellow and green sand and gravel, like those found at the tunnel under the Thames.

"*Account of borings made near London, where the water rises above the surface of the land*.—In Mr. Wilmot's garden at Isleworth, a boring was executed to the depth of 327 feet. The blue clay was found to exist from about twenty-four feet below the ground level, with little variation of colour, to the depth of 240 feet: it is then of a lightish red, and afterwards of a darker colour very much variegated. At the depth of 308 feet it is blackish, and at 310 feet very black; at 311 feet it becomes yellow for some depth; then light green, followed by dark green, out of which the water rises, being a stratum of about ten feet thick.

"All the specimens, with the exception of the yellow, appeared to be clay; the yellow had a sandy appearance. The cast-iron pipe is sunk 327 feet, and is two and a quarter inches diameter. The water rises about ten feet above the ground, and the well supplies eight gallons per minute. The land-water here stands about sixteen feet below the ground.

"Lord Cassilis* has also had a boring executed in his grounds at Isleworth, to the depth of 290 feet: the quantity it supplies is about thirty gallons per minute, and its water rises about thirty feet above the level of the surface."

Passing over several papers of great value on various engineering details, we come to an "account of the new, or Grosvenor Bridge, over the river Dee, at Chester," the boldest and most graceful work of the kind that has ever been executed, spanning the river in a single arch of extraordinary dimensions. From this paper we make the following extract, showing the expense of the work and the dimensions of other arches of great span, all of which, however, are exceeded by the Chester bridge:—

"The total cost of the work was 49,900*l*., in which is included a sum of 7500*l*. for the heavy embankments required in the approaches. The money was partly raised by bonds, and partly advanced by the Commissioners for the Loan of Exchequer Bills, and is secured on tolls charged both on the new and the old bridge, the revenue yielded by which is about 3000*l*. a-year.

"The following table, containing the leading dimensions of the largest stone arches that have been built (from 150 feet span upwards), will enable a comparison to be made between the bridge it has been the purpose of this paper to describe, and others approaching, but not equalling it, in magnitude of arch.

Name.	River.	Form.	Span.	Rise.	Keystone		Date.	Engineer.
			Feet.	Feet.	Ft.	In.		
Claix (Grenoble)	Drac	Circ.	150	54	3	1	1611	
Gloucester	Severn	Ellip.	150	35	4	6	1827	Telford
London	Thames	Ellip.	152	37½	4	9	1831	Rennie
Tournon	Doux	Circ.	157	65	....		1545	
Verona	Adige	Ellip.	160	53	....		1354	
Lavaur	Agout	Ellip.	160	65	10	9	1775	Saget
Gignac	Erault	Ellip.	160	44	6	5	1793	Garipuy
Vieille-Brioude	Allier	Circ.	178	69	5	3	1454	Grenier & Estone
Chester	Dee	Circ.	200	42	4	0	1833	Hartley"

In a country like England, where public works of immense magnitude and expense are continually in progress, it is an inquiry of considerable interest, what are the best and most durable materials for their construction? In answer to some inquiries of this kind respecting the "Herm granite," made by the President of the Institution of Civil Engineers, we have a paper by Fred. C. Lukis, Esq., of Guernsey.

The queries and their answers are the following:—

"1. Of the durability of Herm stone for buildings exposed to air?

"The Herm granite (sienite) as compared with Peterhead and Moorstone from Devon or Cornwall, is a highly crystallized intermixture of felspar, quartz, and hornblende, with a small quantity of black mica; the first of these ingredients hard and sometimes transparent in a greater degree than that found in other British granites,—the contact of the other substances perfect. It resists the effect of exposure to air, and does not easily disintegrate from the mass when mica does not prevail, but as this last is usually scarce in Guernsey granites, the mass is not deteriorated by its presence as in the Brittany granites, where it abounds, decomposes, stains, and pervades the felspar, and finally destroys the adhesion of the component parts:—*vide* the interior columns of St. Peter's Port church, which is built of it, for an instance. The quartz is in a smaller quantity, and somewhat darker than the felspar in colour; the grains are not large, but uniformly mixed with the other ingredients. The hornblende, which appears to supply the place of mica, is hard and crystallized in small prisms, rarely accompanied by chlorite; its dark colour gives the greyish tone to this granite, or when abundant forms the *blue* granite of the Vale parish. This substance is essentially superior to mica in the formation and durability of granites for strength and resistance; consequently its presence occasions more labour in working or facing the block, and its specific gravity is increased. The mica is inferior in quantity to the hornblende, and usually dispersed in small flakes in the mass;—it may, with chlorite, be considered rare.

"2. Do air and water alternately cause any, and what symptoms of decay?

"The compact nature of a close grained granite, such as the Vale and Herm stone, having the felspar highly crystallized and free from stained cracks, seems well calculated to resist the effect of air and water. When the exterior *bruised* surface of a block has been blown off, I do not know a stone better disposed to resist decay;—if the surface blocks of the island are now examined after the lapse of ages, it will be found to have resisted the gradual disintegration of time in a superior degree, when compared with *large grained* or *porphyritic* granite; when exposed to water and air there is no change beyond the polish resulting from *friction* of the elements. Among the symptoms of decay, disintegration prevails generally among granites, usually commencing with the decomposition of the mica; its exfoliating deranges the cohesion of the grains, and it may be considered then to be the more frequent mode of decay. Desquamation is rare with the well defined granites of Guernsey and Herm, and in buildings I know no instance of its existence.

"3. What the greatest age of building, or experience of the above?

"The churches of the Vale and St. Sampson, although much of the materials are French and Alderney, bear many proofs of the remarks made in the last answer; these erections date A.D. 1100—1150. The ancient buildings of decided Herm and Vale stone must be sought for among the old houses in the northern parishes, where they not only encounter the effect of air and water (rain), but the sea air and burning rays of the sun. Disintegration alone appears going on by slow degrees, but in no case affecting the interior of the stone, and so gradual and general as not to deface the building materially; indeed, the oldest proofs taken from door-posts, lintels, and arches, have scarcely lost their original sharpness or sculpture. The pier of St. Peter's Port and bridge of St. Sampson's may also be mentioned.

"The shore rocks in like manner do not show any material change of surface by wearing; where the force of the tide is strongest, a slight smoothness alone may be observed on the exterior particles, and in many instances each substance possesses this polish *without being levelled down to a face*.

"Vale stone on the northern point of Guernsey produces a finer grained sienite than Herm, more hornblende in it, and specific gravity greater. The Herm is somewhat larger grained, but equally good for every erection where durability is the chief point. The *Cat-au-roque* stone in the western part of Guernsey must be considered of a different structure to the above; it is a fair and good stone and appears to last well; its schistose texture must ally it to the gneiss series, and I do not know its counterpart in Britain. In colour it is much the same as the blue granites, the felspar is brilliant and the hornblende prisms are well defined; there is more chlorite in it and it is easier to work."

On the value of the following experiments by Mr. Walker, it is needless to remark:—

"Table showing the result of experiments made under the direction of Mr. Walker, on the wear of different stones in the tramway on the Commercial-road, London, from 27th March, 1830, to 24th August, 1831, being a period of seventeen months:—

Name of stone.	Sup. area in feet.	Original weight.			Loss of weight by wear.	Loss per sup. foot.	Relative losses.
		cwt.	qrs.	lbs.	lbs.	lbs.	
Guernsey	4·734	7	1	12·75	4·50	0·951	1·000
Herm	5·250	7	3	24·25	5·50	1·048	1·102
Budle	6·336	9	0	15·75	7·75	1·223	1·286
Peterhead (blue)...	3·484	4	1	7·50	6·25	1·795	1·887
Heytor	4·313	6	0	15·25	8·25	1·915	2·014
Aberdeen (red)....	5·375	7	2	11·50	11·50	2·139	2·249
Dartmoor	4·500	6	2	25·00	12·50	2·778	2·921
Aberdeen (blue)....	4·823	6	2	16·00	14·75	3·058	3·216

"The Commercial Road stoneway, on which these experiments were made, consists of two parallel lines of rectangular tramstones, eighteen inches wide by a foot deep, and jointed to each other endwise, for the wheels to travel on, with a common street pavement between for the horses. The tramstones subjected to experiment were laid in the gateway of the Limehouse turnpike, so as of necessity to be exposed to all the heavy traffic *from* the East and West India Docks. A similar set of experiments had previously been made in the same place, but for a shorter period, (little more than four months), with however not very different results, as the following figures corresponding with the column of '*relative losses*' in the foregoing table will show.

Guernsey	1·000	Peterhead (blue) . .	1·715
Budle	1·040	Aberdeen (red) . .	2·413
Herm	1·156	Aberdeen (blue) . .	2·821

All the above stones are granites except the Budle, which is a species of whin from Northumberland, and they were all new pieces in each series of experiments."

We observe, with pleasure these investigations tending to establish the relative merits and durability of different species of granite, a material so valuable in itself, and afforded in such exhaustless abundance, both by the northern and southern extremities of our island, yet differing so much in composition and texture, as to render many experiments necessary in order to ascertain the kinds best adapted for certain uses.

The last paper in the volume contains an account of the "recent canal-boat experiments," by Mr. Macneill, with numerous tabulated results. This paper is of course highly valuable to the engineer and canal proprietor, but as it is does not properly fall within our scope, we shall merely make the following short extract, showing the result of some of the author's observations:—

"That in the wide and deep canal, the tractive power was observed to increase with the velocity, but not in any uniform ratio.

"That in the shallow and narrow canals, the increase of tractive power had a limit at a certain velocity; and, under certain circumstances, even decreased with the increase of velocity; so that it appears probable, that if the size of the canal bear a certain proportion to that of the boat, there is a certain velocity at which a boat may be drawn on a canal with a minimum tractive power. This velocity, on the Monkland and Paisley canals, with boats like the Zephyr and the Swift, appears to be about nine miles per hour. And I think it probable that a similar effect would be observed on the Forth and Clyde canal, if a boat similarly proportioned to that canal were used, though the velocity and the minimum tractive power in such a case might be different from those on the other canals."

Our lengthened notice of the "Transactions of the Institution of Civil Engineers," will have so fully informed our readers of the nature of its contents, and of the high opinion we entertain of their merits, that further comment or remark is almost unnecessary. We consider the volume to bear most honourable testimony to the zeal and energy of the society from which it emanates, and as of the highest value to engineers generally, but more especially to the rising members of the profession, who are thus put at once in possession of many of those valuable data which have been accumulated by the indefatigable labours and long experience of their predecessors. We consider the pursuits of the civil engineer and the mining engineer to be closely allied to each other, to be, in fact, branches of the same profession, and it is with this view that we have extended our notice to so great a length, and entered so fully on the general bearings of the subjects coming under our consideration.

Journal of the Franklin Institute of the State of Pennsylvania. Edited by THOMAS P. JONES, M.D. Vol. XVIII., No. vi.—Vol. XIX., No. i. Published by the Franklin Institute. Philadelphia. 1837.

The two numbers of this work, for the months of December and January last, are now before us; the most important articles they contain are the concluding portion of a Report of the Committee of the Franklin Institute, "On the Explosions of Steam-boilers;" "Observations on Microscopic Chemistry," by John W. Draper, M.D.; and a "Report on Hourly Observations of the Thermometer at Frankford Arsenal, Pennsylvania," by Captain Alfred Mordecai, of the United States Ordnance Department. There is also a description of two new machines for cutting out and milling coin, by Mr. Franklin Peale, of the United States Mint, which will possess some interest with our mechanical friends, as they appear to have been adopted with success in America.

The following sentence, with which Mr. Peale introduces the notice of one of his machines, is full of good sense, and should be kept in mind by all who direct their attention to the mechanical arts:—

"It is always desirable in the construction of machines, that there should be no redundancy of parts, and that they be made as simple as is consistent with efficiency of operation. It is also equally desirable to distribute the requisite parts in as symmetrical a form as the object of their construction will permit, not forgetting that the laws of good taste are as applicable to machinery as to architecture, or to any other form in which inorganic matter may be presented to the eye. It was under the influence of these sentiments that the machine which is the subject of this notice was designed."

The results arrived at by the Committee on the Explosion of Steam-boilers, are chiefly detailed in a project for a law regulating the boilers and engines of vessels propelled by steam, which is too long and technical for extract; the concluding passages of the report, will, however, afford some idea of their views:—

"Having closed the subject of the means of preventing explosions in steam-boilers, the committee have yet to consider *whether it is possible to provide protection against their effects when they occur*.

"The very respectable scientific and practical men who have at different times drawn the attention of the public to this matter, give undoubted authority to the suggestion. The means proposed are, by carrying the passengers in a separate boat from the engine, or by placing the boilers on the guards of the boat, and separating them from the parts occupied by the passengers, by a suitable bulwark.

"In regard to the first of these plans, it has been attempted, and for want of sufficient patronage by the public, has been laid aside. Public opinion seems to set strongly towards precautions which shall render the engine safe, without crippling its power of giving speed.

"The larger steam-boats in our Atlantic waters have generally the boilers upon the guards, but without any obstruction between them and the inner parts of the boat. This affords but a partial security, diminishing probably the extent, but not preventing, the destruction of human life. That a bulwark of sufficient strength to protect against explosion, without adding too much to the weight of the boat, can be devised, the committee are not prepared to assert positively, though they believe that it could.

"Their views incline entirely to the protection of the hands, as well as passengers by rendering the boiler safe, and they fully believe that this may be done without incumbering the boats now in use, or requiring, in a majority of cases, an entire change of structure in the engine.

"They have, however, to meet opinions which they hold in so much respect, introduced a clause in the proposed bill, annexed to this report, by which a bounty is, in fact, offered upon a boat constructed with suitable bulwarks between the interior part and the boiler.

"The committee having now completed their examination of the causes of explosion, with their preventives, as far as they are informed upon the subject, and made all the recommendations, which this examination has suggested to them, refer to the accompanying project of a law for the regulations of the boilers and engines of steam-vessels, for the means of carrying the more important of these suggestions into effect.

"The provisions of this law refer only to the means of preventing the explosions of boilers of steam-boats, or of affording protection against their effects. With the regulations in regard to the navigation or police of the boats, however important, this committee do not feel warranted in interfering. They believe that the experience necessary to frame such regulations will be found in the appropriate committees of Congress, upon whose attention they would respectfully urge the annexed provisions relating to the engine.

"That such an enactment will contribute to the safety of the public, without interfering injuriously with those interested in the navigation by steam or in the manufacture of the steam-engine, is the deliberate opinion of this committee."

Should the precautionary measures recommended by the committee, evidently the result of a long and patient investigation of the subject, be adopted, we have little doubt that the dreadful steam-boat accidents, which now occur so frequently in America, will be greatly diminished—a result which it will be worth some sacrifice to obtain.

First Russian Railroad, from St. Petersburgh to Zarscoe-selo and Pawlowsk, established by Imperial Decree of 21st March, 1836, *and carried into execution by a Company of Shareholders in Russia, England, and Germany.* Translated from the German. St. Petersburgh, 1837. Skipper and East, St. Dunstan's-hill, London.

This pamphlet contains much interesting information relative to the first line of railway undertaken in the Russian empire, and appears indeed to consist, in a great measure, of the reports of the Chevalier von Gerstner, the engineer employed in this work, combined together and placed in a connected form for public convenience.

On looking over the pamphlet before us, we have been pleased to observe the penetration and enlightened views displayed by the Emperor, in at once recognising the beneficial tendency of this species of communication, and deciding on its immediate adoption in his dominions; the whole proceeding, indeed, displays a degree of spirit and liberality which is most honourable to the Sovereign, while it cannot fail to prove highly advantageous to his subjects. Privileges, the most extraordinary, are granted to the undertaking—the crown lands are gratuitously ceded to the company, and the lands of individuals are placed in its possession by a summary process, leaving the terms of compensation open, so as to avoid all unnecessary delay—the whole quantity of iron is allowed to be imported duty free, under a mere nominal restriction; the same privilege extends to the locomotives, carriages, and other machinery, and foreigners are allowed to embark as shareholders in the undertaking, on precisely the same footing as Russian subjects, while no restriction is laid on the amount of fares of goods or passengers. Favoured with these and other extraordinary privileges, the necessary capital was soon subscribed, and notwithstanding the difficulties opposing themselves to the work, from the necessity of importing almost every requisite from abroad, and that at a time when orders of this description could hardly be executed fast enough to supply the demand, within the short space of eight months after receiving the Emperor's sanction, a portion of the railway was completed and opened; and during the present summer, or about fifteen months after that time, it is expected that the whole line (about seventeen miles in length) will be completed and opened for public use.

Such is a brief statement of some of the principal facts connected with "the first Russian Railroad," an undertaking ensuring great advantage to the shareholders, and promising much ultimate benefit to the country in which it is established. The report contains, however, so much interesting matter, that we shall, in a future Supplement, extract at least the introductory portion, considering that the subject is well worthy of the attention of the English capitalist, as other works probably invested with similar privileges, and promising the same beneficial results, will no doubt shortly follow the present.

The Engineer's and Mechanic's Encyclopædia. Parts XV. and XVI. By LUKE HEBERT, Civil Engineer. Kelly, London.

Having previously noticed the progress and design of this work, we have little more to do on the present occasion, than to announce the publication of the fifteenth and sixteenth parts, and to state that the whole series will shortly be completed by the appearance of the two following ones. Without possessing any great claim to originality, the "Engineer's and Mechanic's Encyclopædia" is likely to prove a very useful work, and more especially to those who have not access to the numerous, bulky, and expensive publications, which treat in detail of the subjects to which it relates; we should, therefore, recommend it to such of our readers as may be desirous of possessing, in a convenient form, and at a moderate expense, the most important information required by the mechanic and engineer.

EDGE RAILS.—The edge rail has now entirely superseded the tram or train-plate, and is used in all railways worked by locomotive engines. This form of rail causes much less friction to the wheels, there being considerably less surface of the former coming in contact with the latter. These rails are made of wrought iron, in 15-feet lengths, with an upper flanch slightly curving from the middle to the sides; the weight of rail is regulated by the tonnage passing along the line. On the Stockton and Darlington, Manchester and Liverpool, and Leeds and Selby Railways the weight per lineal yard of the original rails is 35 lbs. On the Manchester Railway, however, rails of 75lbs. are being substituted. The size of the 35lb. rail is 3¼ inches in depth, 2¼ inches as to the width of the upper flanch, and the upright portion three-quarters of an inch thick. The original rails of the London and Birmingham Railway are 50 lbs. weight, as also those of the Greenwich Railway; but on the former line 75lb. rails are being laid down, to a considerable extent. The Manchester and Bolton rail is 50lb. to the yard, but differs in shape from those used on every other railway. The top flanch is 2½ inches wide, the bottom flanch 4½ inches wide, the depth $2\frac{7}{10}$ inches, and the thickness of the middle portion three quarters of an inch.—*Whishaw's Analysis of Railways.*

* Now Marquis of Ailsa.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. IX.

ON THE ECONOMY OF MIXING GUNPOWDER AND SAWDUST IN BLASTING.

(From a Letter of Mr. Thürnagel, of Tarnowitz, in Silesia, to Dr. Karsten, Editor of the "Mining Archives.")

We continue our series of Foreign Extracts, by the following details of experiments in blasting, made in mines with a "mixture of sawdust and gunpowder"—a subject to which we have previously directed attention, and we again invite the communications of our practical mining friends, describing any trials they may be induced to make with this mixture :—

In a former communication to your interesting Miscellany, I stated the result of my experiments with an equal mixture of powder and sawdust for blasting. The experiments alluded to were persevered in for two months underground, and led to the assurance that the new method is highly advantageous to the parties interested in mining operations ; in proof of which, the tribute has been lowered in these mines from twenty-five dollars to twenty-three dollars, it having been clearly shown, that by the use of the mixture, from eight to ten pounds of gunpowder are saved in every fathom. This fact will tend more than anything else to demonstrate the benefit to be derived from this improvement, so that I need add nothing more by way of remark, but shall, at present, merely submit to the mining public a description of the particular manner in which the mixture has been found to answer the anticipations entertained respecting it, which is the more necessary at the present moment, as opinions are divided on the subject. It was from the first my conviction, that the sawdust could only promote the ignition of the powder by giving more space for its expansion, and by imparting a greater looseness to the whole mass. Others, again, and Mr. Selb, superior mining councillor, in the number, were of opinion that the gases evolved from the sawdust in combustion, augmented the power of the mixture, and that an incombustible substitute would not prove so effective. In order to demonstrate the truth of one or the other of these positions, I instituted a certain number of trials, with a mixture of equal parts of powder and sawdust, obtained from boring a piece of timber for a pump. It was evident from these experiments, which on the whole fully realised the hopes I had entertained, that the effect was in no wise owing to the presence of any gases ; and I am inclined to give the following solution the preference to any other. The sawdust derives its efficacy solely from its looseness and elasticity, by which the grains of the powder are kept apart from each other in the cartridge, and a number of small tubes are thus formed, which combine to produce a simultaneous ignition of the whole mixture. This naturally produces a more powerful effect and a less sudden explosion, than is the case with powder alone. For the same reason few or none of the grains of the powder, when mixed with the sawdust, can be thrown out of the cartridge without exploding, which seems to be always done when powder alone is used. In those trials which were made in a part of the rock, abounding in crevices and small cavities, the mixture was less effective than in the compact rock ; and it therefore appears to me, that the great number of fissures in the stone-coal formation, prevented the most part of my experiments in the Königsgrube coal mines from succeeding. The impossibility of fitting the ball on with sufficient firmness, in using large pieces of ordnance, may probably be the principal obstacle to the adoption of the mixture in the artillery.—*Karsten's Archiv.*, vol. i.

In addition to the observations of Mr. Thürnagel, of Silesia, we beg leave to lay before our readers those of Mr. Schultz, of Berlin, mining inspector and assessor of the Mining Court, made by him (among other numerous notes) on his tour in the month of August, 1818, through the mining districts of Saxony and part of Bohemia, and inserted in Dr. Karsten's periodical work on Mining, Metallurgy, &c., for the year 1820.

After giving interesting details of the methods of working in different mines, he remarks, with reference to the Freiberg works, that in blasting, the usual plan there adopted is to give the holes which are worked by two men, a depth of sixteen to twenty-four inches in stoping, and to allow half an ounce of powder to an inch length of cartridge, and one inch of width in the hole. The bores, called from their size, man-and-a-half-bores, being twenty-eight inches deep in the back of the stope, require eight ounces of powder in a cartridge of twenty inches long. One-man-holes, of twenty inches deep, usually take fourteen inch cartridges, and five and a half to six ounces of powder ; one-man-holes, fifteen inches deep, three to four ounces of powder. The same proportions seem to obtain in the other mines of this district. In the John George mine the cartouches are shorter, and those intended for bores twenty inches deep, were only eight, or at most nine inches long, for this reason, the trials made here with a mixture of sawdust with the powder were not so favourable as at Freiberg. This mixture has not yet been adopted here, but yet the saving of powder could not be otherwise than beneficial to all parties. If, as it may be anticipated, the consumption of this article be reduced to two-thirds, the bargains with the workmen will be proportionably lowered ; and a pitch, charged at twenty-five dollars, with a consumption of fifteen pounds of gunpowder, would cost one and one-third dollars less—so that in five tons of gunpowder 1100 dollars are saved ; and since the annual consumption of powder in the Freiberg mines is sixty tons, the total saving would amount to 13,200 dollars, about 1885*l.* sterling.

In the single mine, "Bescheert Glück," near the "Three Crosses," the amount of powder economized would be from 1200 to 1600 dollars annually.—*Ibid*, vol. ii.

With reference to the above extracts, we may observe that they bear date 1818 and 1820, and therefore describe the process referred to in its earlier stage of trial, and previous to its entering into such general use, and its utility being so fully acknowledged as is now the case.

Asia Minor.—M. Texier, in his summary account of the geological construction of Asia Minor, describes the Black Sea, of which it has hitherto been supposed that, in consequence of some violent shock, its waters opened a passage for themselves, and in so doing caused the deluge of Samothracia ; but on examining the two sides of the Bosphorus, M. Texier says, they are of such different strata, that they never can have been united. The European side is composed entirely of trachyte and analogous rocks, and the Asiatic of transition limestone. The trachytes have a blue ground with white crystals, and extend in a width of several leagues, as far as Belgrade and Kila. If the Bosphorus diminish, as reported, it is probably owing to the effusion of the trachytic rocks on the European side.

Zoological Society of Paris.—At the Garden of Plants, on Monday week, the giraffe appeared in the open air for the first time this season here. The gallery of mineralogy is now completed, and the specimens are about to be placed. The fine hot-houses are already filled with equatorial plants. The monkeys will, in a few days, be removed to the magnificent dwelling prepared for them.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—May 3.

Rev. W. Whewell, President, in the chair.

The first paper read, was one by Mr. Darwin, describing the district in which had been found the remains of the Toxodon, described at the last meeting by Mr. Owen. The countries bordering the Rio de la Plata contain, in great numbers, the remains of extinct animals. The province of Bander Oriental consists of granitic, and other primary rocks. The flat and extensive plains of the Pampas are very uniform in structure over a very extensive tract. A reddish, argillaceous earth, covers the surface with irregular concretions, of an aluminous limestone or indurated marl, which sometimes unite and form a stratum often replacing the former ; both containing occasional layers of crystallized sulphate of lime. In the province of Entre Rios, these rest on strata consisting of sand, layers of clay, and a fine white crystalline limestone, containing shark's teeth, Arca, Venus, and Pecten, all resembling recent shells. But it is in the superincumbent deposit that are found the fossil Mammelia peculiar to this district, consisting, besides the Toxodon, Megatherium, a lesser animal protected by an armadillo-like covering, Mastodon, another singular animal, of which only half the head has been preserved ; and, as Mr. Darwin believes, also the horse.

In several places, Mr. Darwin observed clear proofs of a change of the level between land and water. These he considers connected with the greater changes on the opposite coast ; and concludes, that within a period geologically recent, a great bay occupied the area both of the Pampas and the low parts of Bander Oriental. Into this the river poured, as in the present day, reddish sediment from the decomposition of the granites of Brazil, and charged with lime and gypsum, perhaps from the Cordilleras. The bodies of the animals which formerly inhabited the surrounding country, must have been likewise swept into this bay, which has now been elevated into dry land.

An extract of a letter, dated 18th November, 1836, from Captain Cautley to Dr. Royle was next read, permitting the announcement of a fact, which had long been communicated to the latter, of the finding of the remains of a Quadrumandus animal in the Sewaliks, or Sub-Himalayan range of Mountains. The animal must have been much larger than any existing one, and allied to Cuvier's Cynocephaline group. Captain Cautley also announced the discovery, by Major Colvin, of a specimen of the head of the Sivatherium, in which, in conformity to the conjectures of Dr. Falconer and Captain C. in their paper, for which the Wollaston medal was this year awarded, it is found that the animal had four horns ; two in front, and two huge trifurcated ones behind. He considers the animal as allied to the Dicranocerine group of Major Hamilton Smith.

A paper, by Messrs. Hamilton and Strickland was then read, on a tertiary formation in the Island of Cephalonia near Lixouri, on the western shore of the gulf of Argostoli. The parallel ridges composing it extend for two or three miles to the north and south of Lixouri, sloping to the east according to the dip of the strata, or from 45° to 55°, and presenting a succession of steep and sharp escarpments towards the west. The conformable beds are of great thickness, and are remarkable as well for the great beauty and number of the fossils, as for the variety of beds through which these extend. The beds, of which sixteen are enumerated, may be classed under three principal heads. First, the calcareo-arenaceous ; second, the argillaceous ; third, gypseous beds. The fossils belong to numerous genera, and many of the species are identical with those existing in the Mediterranean.

INSTITUTION OF CIVIL ENGINEERS.—April 11.

— Walker, Esq., President, in the chair.

Mr. Brunel gave an account of the Thames Tunnel. He explained the nature of the former operations of Vazie and Trevethick, by whom a tunnel five feet in height, two feet six inches in breadth at the top, and three feet at the bottom, had been carried more than 1000 feet. But in 1808, the river broke in upon it, and the work was irretrievably lost. It was from the data furnished by this operation, that his opinion of the practicability of the present undertaking was formed. The present excavation is thirty-eight feet in breadth, and twenty-two feet in height, and the support which is requisite for the ground, is furnished by the shield. The shield consists of twelve parallel frames ranged side by side, each frame being divided into three cells or partitions, by two floors. Mr. Brunel explained, by reference to drawings, the adjustment of the floors, the contrivances by which each frame was made to derive support from, or assist in supporting its neighbour, as necessity might require ; and the manner in which it was advanced. Each frame stands on two legs, and advances, as it were, by short steps ; having, for this purpose, an articulation very like that of the human body. The advantage of the system of building by rings, which he had adopted, had been fully demonstrated by the fact of the brickwork having sustained two irruptions, and yet exhibited no symptoms of rupture. The chasm formed at the last irruption absorbed more than 80,000 cubic feet of clay bags, before the workmen could re-enter the works. The greatest inconvenience under which they laboured, was the want of a drain ; they had attempted to make one—but, getting into the stratum of quicksand fifty feet thick, which is at a small depth below them, were obliged to abandon the project. The land springs were a great source of annoyance ; many of these were extremely offensive, and produced cutaneous eruptions, and were a great source of annoyance to the workmen. The difficulties of the work are vast, but there could be no doubt, but that in time they would be surmounted : the progress at the present point is necessarily exceedingly slow.

At the following meeting, on the 18th of April, Mr. Brunel explained those points on which individuals present wished for information. The increase of the water informs them of what is going on above, and they guard against it accordingly. They had been much troubled by the unusually high tides of the present spring ; the change from low to high water is exceedingly trying ; in the natural ground it is usually attended with an increase of water, but in the ground made with clay bags, with a diminution. The works had advanced 127 feet since the introduction of the new shield. Some inquiries were made on the means adopted for ventilating the works, and considerable discussion took place on the methods of ventilation by rarefaction and condensation—that is, by drawing out or forcing in air. Mr. Brunel stated, that respiration and the pulse were slower in the diving bell, where condensed air was breathed, than under other circumstances.

A paper was then read, descriptive of a new levelling machine, invented by Mr. Harrison, of Edinburgh. This machine is to be drawn along by horses, and is intended, by registering the rise and fall of the roads, and the space passed over, to make at once a section of the country.

April 25.—A paper by Mr. Beamish, relating to the Thames Tunnel, was read.

Mr. Trubshaw having presented to the Institution a model of the centre employed by him in constructing the arch of Chester Bridge, being the largest stone arch in the world, considerable discussion took place respecting it. Mr. Trubshaw pointed out the peculiar features in the construction of this centre, and the means which had been adopted so successfully in building the arch.

Mr. Macneil then exhibited the method which he had adopted, of projecting the sections on the survey in Ireland. On one side of the line the cutting might be represented, on the other side the embankment. The scale being applied to these, the extent, depth, and height of each would be seen. A plan being hung up, so as to bring any particular portion of a line nearly horizontal, the eye would see at once the amount of each ; and on two lines being thus compared, the reasons for adopting one and abandoning the other, would frequently be at once apparent. He proposed also to use the term acclivity for the ascents, on going from some chief place, and declivity for the descents, and to mark a rate after them.

ASHMOLEAN SOCIETY AT OXFORD.

At a late meeting of this society, the arrival of several large boxes of organic remains collected in the Himalaya Mountains, and presented to the Society by Lieut.-Col. Stacy, was announced. The contents of them consist principally of the bones of the elephant, mastodon, and hippopotamus. Doctor Buckland has undertaken to give an account of them to the society. Dr. Daubeny then gave a description of the rocks of Adelsbach, on the Bohemian frontier, a day's journey from the Riesengebirge, or Giant Mountains of Silesia, which are remarkable for the weathered condition of the sandstone of which they consist. The rock is the Quadersanstein, and corresponds to the green-sand formation of this country ; it is a continuation of the rock through which the Elbe flows in that district of Saxony known as the Saxon Switzerland. The whole of this sandstone formation, occupying a space of not less than four miles by two, is divided into polyhedral masses to a depth of not less than 100 feet (from the upper surface). The causes may be considered to be the force of running water and the downward action of rain, to which Dr. Buckland thought that the force of the wind should be added.

LIVERPOOL AND MANCHESTER RAILWAY.

[We extract the following from the *Times*, and, without offering any opinion on the correctness of the deductions drawn by the writer, consider it deserving a place in our columns, as affording opportunity for those who may be shareholders in other companies, by analogy, to form opinions of estimates and results.]

We would recommend to capitalists and the public the perusal of a Bill now in progress through Parliament for amending the Acts under which the above great undertaking was formed. The following curious and interesting facts appear on the face of this document :—

The Liverpool and Manchester Railway was incorporated by Act of Parliament in the year 1825. The capital of the company was 510,000*l.*, apportioned in 5100 shares of 100*l.* each, and on this capital the company was restricted to a dividend of 10 per cent.	£510,000 0 0
In the year 1829 this capital was increased by an addition of shares to the extent of	127,500 0 0
In the year 1830 it was again increased by an addition of shares to the extent of	159,375 0 0
Under subsequent Acts the company have raised by sale of shares, or obtained on loan, further sums to the extent of	427,500 0 0
By sale of shares and borrowing, the company have thus raised a total sum of	£1,224,375 0 0

Of this amount 808,025*l.* has been converted into stock ; the remaining sum of 416,350*l.* is held on loan by the company.

In the bill now before Parliament it is stated, "that the whole sum of 1,224,375*l.* hath been expended in or about the said undertaking, railway, and works ;" but that though the railway has been opened to the public, "the same, and the works connected therewith, are not yet completed ; and that it is expedient the company should be authorized to raise more money for the purpose of the said undertaking." On this narrative the bill proceeds to authorize the Liverpool and Manchester Railway Company to raise, by the sale of shares, or to take up on loan, an additional sum of 400,000*l.*, in order to complete and finish the railway—thus raising their capital to the enormous sum of 1,624,375*l.* sterling.

The entire length of the Liverpool and Manchester Railway is, including the two tunnels, each of a mile in length, at Liverpool, about thirty-two miles. It has already cost 38,260*l.* per mile, and to complete it the company require to raise and expend an additional capital of 400,000*l.*, equal to 12,500*l.* per mile—thus raising the cost of each mile of their railway to upwards of 50,000*l.*

The railway was opened for traffic from end to end in September, 1830, and in the period of six years which elapsed from this opening till the year 1837 the proprietors have divided 442,504*l.* 7*s.* 6*d.* In the same period they have obtained on loan, or by sale of shares, a sum considerably exceeding this amount paid away in dividends.

Supposing the Liverpool and Manchester Railway Company to continue their present dividend, and to borrow this sum of 400,000*l.*, and expend it during the next four years "in or about the undertaking," as specified in the present bill, it will afford the astounding example of a public company, who, while they have distributed, on the one hand, to their proprietary, in the course of ten years from their commencing business, a sum equal to nearly double their original capital, have, on the other hand, succeeded in borrowing from the public, during the same period, a sum exceeding the whole dividend so divided among the proprietary.

By the bill now before Parliament the Liverpool and Manchester Railway Company are authorized to borrow the 400,000*l.* now wanted from Government—that is, the Exchequer Loan Commissioners ; and it is provided, that in case the money is advanced by Government out of the public funds, the loan is to be preferable to the sums the railway company have already borrowed from individuals, or, in other words, the interest of the 400,000*l.* to be advanced by Government to complete the railway is to be made preferable to the interest of the sum of 416,350*l.*, the amount of the prior railway debt to individuals.

The Liverpool and Manchester Railway are already creditors to the public to a considerable amount, and have in the period of six years, during which they have been in operation, received from the public a bounty of upwards of 200,000*l.* in the shape of an exemption from taxation on their coaches and passengers, to which they would have been liable, had their railway been a turnpike road, and they themselves coachmasters on this road. Their claim to a further loan of money from the public may, therefore, be doubted.

ANNUAL EXPENDITURE.

The cost of working the Liverpool Railway for the year 1836 (if the reports published by the directors be correct), was, deducting interest paid on borrowed money, 133,225*l.* 7*s.*, or at the rate of upwards of 420*l.* per working day. Of this sum 41,952*l.* 5*s.* 8*d.* is stated to be the cost of locomotive power for the thirty miles of railway on which locomotive engines are alone employed. The cost of locomotive power was, therefore, just 1400*l.* a mile.

While the facts above-stated are startling to parties who believe in and promulgate the doctrines of the cheapness of railway formation and maintenance, what a light do they not throw on the profound wisdom of "Parliamentary private bill legislation ?"

About 30,000*l.* was expended by the original promoters of the Liverpool Railway in order to prove to Parliament that it could be easily completed at a cost of 510,000*l.*, or about 16,000*l.* per mile, as stated in the first act of incorporation. Since that period nearly as much more has been expended in Parliament in obtaining new acts, which demonstrate that the railway will cost more than three times 16,000*l.* or 50,000*l.* sterling per mile, and that the original proof was an entire fallacy.

Nor is this instance a solitary one. About three years ago, the promoters of the London and Birmingham Railway were compelled to spend 50,000*l.* in proving to Parliament that it could be formed for 2,500,000*l.*, or about 22,000*l.* per mile. The London and Birmingham Railway Company are now before Parliament, proving it must cost 4,500,000*l.*, or about 40,000*l.* a mile, and this at a period when the undertaking is little more than half finished. In the course of a year or two this estimate will no doubt be raised to the Liverpool Railway standard of 50,000*l.*

To work this railway at Liverpool railway prices will cost about 500,000*l.* a year, or about 1600*l.* per day, of which 150,000*l.* will be for locomotive power alone.

It is needless to multiply examples—it is sufficient to say that many thousand pounds are now in progress of being expended every week before Parliament, in proving that lines of railway can be completed through difficult tracts of country at from a third to a fifth of the cost which experience has demonstrated as necessary to construct a perfect modern railway, and that when completed they can be worked and maintained for a half and a third of the cost per mile now expended on the Liverpool Railway.

Silex.—M. Turpin has submitted the silex sent from Berlin by M. Ehrenberg, to microscopic observation. The magnifying power amounted to 260, and this gentleman found, that the semi-opal of Berlin is a conglomerate of a number of silicious particles and fragments of organic remains, the colour of which varies from transparent white, and passes through yellow, to the deepest and most opaque brown. M. Turpin recognised four different bodies ; the first of which he referred to the genus *Gaillonella* of M. Bory St. Vincent, or *Conferva moniliformis* ; the second he considered as a different species, of the same genus ; the third was a mixture of tubular filaments, divided into cells at rare intervals, and remains of infusoria ; the fourth was not organic, but served as a basis for rendering the whole solid. The *Silex pyromaque* of Delitzsch, is much richer in organic productions, offering some very remarkable forms, probably belonging to the eggs of Polypi.

Railway Superseded.—On Saturday last, the Leeds and Birmingham Telegraph coach, driven by the celebrated *Ned Aspinall*, started from Leeds at a few minutes before six o'clock, and arrived in Derby eight minutes before eleven, a distance of seventy-two miles. This exceeds in speed almost all in the annals of coach travelling.

DISCOVERY OF THE MINES OF FAMATINA.

[The extraordinary wealth which Nature has deposited in the mountains of Mexico, Peru, and of other parts of South America, and the rich harvest of the precious metals which has often been obtained by the enterprising adventurers, sometimes in a comparatively short space of time, have occasionally given rise to occurrences so singular that the relation possesses rather the appearance of romance, than the sober colouring of real history. The following story is of this class, and extraordinary as are the events described, we believe the occurrences to be well authenticated.]

The great mountain of Famatina, situated in the province of Rioja, has long been looked upon traditionally as the depository of enormous wealth in the form of gold and silver ore; but the turning this wealth to any important practical account, is a circumstance of very recent date; partly owing to the superstitious feelings which the native Indians have always connected, and still connect, with the supposed demons and other supernatural beings who are believed to inhabit the mountain; but chiefly, no doubt, from the absence of any sufficient motive, on the part of the occupiers of the surrounding country, to encounter the perils and hardships attendant on exploring the scene of those, to them, useless and unnecessary treasures: for so rich and fertile are the surrounding plains of the Rioja, and the Pampas, and so comparatively trifling is the labour required to obtain from them all which the simple-minded inhabitants need for their subsistence and comfort, that probably nothing but an actual display of the physical consequences (in wealth and consideration) to be gained by the enterprise in question, could have induced them to commence or continue the prosecution of it, even *since* the revolution, and the new train of motives and feelings which that event has introduced. But before that period the wealth of the Famatina mountain remained a treasure of the imagination merely; and was, as such, as much superior to the actual possessions of the miser, who has not the heart to use what he has hoarded, as the feeling of having all one's wants supplied is to that of wants increasing in the exact ratio of the supply to which they refer. The innumerable herds of the Pampas, to be had almost by seeking for—the inexhaustible fertility of the soil, requiring nothing worthy of the name of toil in its tillage—the peculiar character of some portion of the vegetation, serving for almost every purpose connected with the actual wants of human life, and, finally, the beautiful, but enervating and relaxing climate; all these things united, afforded ample means of content to the comparatively few inhabitants of the vast province of Rioja; which, even at the present time, does not number more than twenty thousand souls. It is true the King of Spain and his government have made repeated attempts to work the mines, known to have formerly existed in this mountain. But they could never hit upon any inducements sufficiently strong to secure the earnest and active co-operation of the inhabitants, or even to overcome that superstitious horror which had been left as a legacy to them by their simple, but, in this instance, perhaps, wise ancestors, relative to the dangers—unnamed and unknown, but not the less effectual in their influence—attendant on the task of exploring the vast and naturally terrific solitudes immediately surrounding the objects of their search. The early Indians, just referred to, had also adopted another precaution, as if with a view of deterring their descendants from the perilous enterprise in question—perilous even, more on account of the cupidity which its results excited in their European masters, than in the actual physical hardships and evils connected with it. On ceasing to work the mines, they carefully built up and concealed, by every means in their power, the various openings to them, so as to remove all clue, if possible, to the exploring of them in future.

It should be mentioned, however, that just before the great discovery, now about to be described in detail, a slight impulse had been given to the Riojanos, to avail themselves of the wealth which all believed to be at their disposal, if needed, by the smuggling trade, which commenced at the opening of the present century, between the province and Buenos Ayres, in articles of English clothing. The desire of being more gaily clad than their neighbours—a desire always to be put in action in idle and unoccupied bosoms—had induced a few of the inhabitants to undertake mining expeditions into the heart of the desolate mountain; and the consequence was, that a little silver got into circulation in the province—a thing, till then, almost unknown. At length, in the year 1805, about four years after the slight and insignificant attempts just referred to, there were seen one day riding into the village of Chilecito, two wretchedly-clad men, both mounted on one sorry mule, and armed with one old musket. On inquiry, it appeared that these men had travelled from Peru, in the manner just described, and had supported themselves on their journey, entirely by the aid of their old gun, with which they had killed, from time to time, what they needed for their subsistence. It was ascertained, too, that, having been long engaged as labourers in the Peruvian mines, and having acquired the knowledge necessary for their purpose, they had left that country solely with the view of seeking their fortune in the mountain of Famatina—the traditional reports of its wealth having long ago reached the country from which they came. These two men were named Juan Leita, and Juan Echavaria; and I have been told by persons who were eye-witnesses to their first entry into Chilecito, that nothing could exceed the astonishment excited in the inhabitants of the village, at the idea of two poverty-stricken and almost naked beings attempting to contend with the dangers and rigours of the so dreaded solitudes of the Famatina mountain. But these men, unlike the happier inhabitants of the fertile plains of Rioja, had long felt the evils of poverty, and craved the advantages which they had been accustomed to see enjoyed by the possessors of wealth alone; and they determined to risk, and to bear every thing, with the view of bettering their condition. This is the class of persons from which we are to look for those discoveries and achievements, which demand unwearying perseverance, and suppose and include constant privation. These two penniless and friendless adventurers from a distant land looked on the wondrous mountain of which they had heard so much; and seeing in its now visible form literally "a mine of wealth," they determined within themselves to explore and take possession of its treasures, or perish in the attempt. On their arrival at Chilecito, they were literally destitute of every thing necessary to their enterprise, except that unquenchable desire and determination to accomplish it, which constitutes, in such cases, great part of the required power. They had not even brought with them any of the mining tools necessary for the commencement of their operations, nor a farthing of money to purchase them. These, therefore, together with the supply of provisions indispensable to their very existence, while working on a spot near which none could, by possibility, be procured, they contrived to obtain, on credit, from a curate of Chilecito, named Granillo, who agreed to supply them with what they needed, to the amount of thirty dollars, on condition, that if they succeeded in their undertaking, they were to repay him double the amount within a certain time; and, within these supplies they started for the mountain, the very day after their arrival in its neighbourhood. They proceeded on foot themselves, as it was necessary to load their mule with the provisions, tools, &c., which they were enabled by the curate to take with them. It is said that the hardships they endured, for the first three or four days, were almost incredible; for, during the whole of that time, they were exposed to the fury of a snow storm, almost naked, and without firing, or even shelter. At the end of that time they had contrived to dig out a small cave in the side of the rock, to shelter them at night from the snow and rain; and there they used to lie close together, with no other means of avoiding being frozen to death, but that of receiving the animal warmth of each other. Their only provisions were biscuit, and a little dried beef, or *charqui*, which they were obliged to eat cold—having, as I have said, no means of procuring firing of any kind. Nevertheless they persevered—their first attempt being made at that part of the mountain called the Cerro Negro, where, after working for some time, they discovered a small vein of virgin silver, mixed with sulphuret of silver. They continued working upon this for about a month, never quitting the mountain during that period; at the end of which time, having collected together as much ore as they could carry, they returned with it to Chilecito. As all mining speculations had ceased in that neighbourhood, they were now at a loss how to turn their little treasure to account, by reducing it to a tangible form. This, however, they at last effected by grinding the ore to powder, on a large flat stone, as painters grind their colours, and then triturating it with mercury to extract the silver. The produce of this their first adventure was about one hundred dollars; with which, having first paid the curate his promised sixty dollars, they purchased more provisions and a little clothing, and then returned to the mountain, and were heard of no more for three months. At the end of that time, one of them came back to the village, with sufficient silver ore to purchase two additional mules, for the purpose of bringing back the increasing produce of their labours. And thus they went on for about twelve months, never quitting the mountain but when compelled to return in search of provisions. It was understood that, by this time, they had accumulated a capital of about two thousand dollars; and about this time it was that they discovered the rich mine called Santo Domingo. They now found themselves sufficiently fortified with the world to feel justified in hiring labourers from the village to work for them; and having also purchased a spot of ground in the valley of Famatina, in which there was a convenient fall of water from one of the mountain rivulets, Juan Leita, who was a man of great mechanical ingenuity, constructed with his own hands a trapichi mill, for the purpose of grinding the ore on a larger scale. The whole of this construction he completed without assistance; and then, being the hardier man of the two, he returned to the mountain to work and superintend the operations there, while Echavaria came to reside at the mill, and attend to the extraction of the metal from the ore.

In this manner they proceeded for ten years, by which time they had accumulated a capital of a hundred thousand dollars. But in doing this, they had excited the malicious envy of the Riojanos, whose cupidity made them covet the wealth, which their want of industry prevented them from even attempting to compass for themselves by similar means. At this period, too, the revolution broke out, and afforded the means of, in some measure, accomplishing the object now contemplated by some of the heads of the people. The first step taken against them, was to order them to pay a thousand dollars for the service of the state. This was no sooner complied with, than another demand was made for a similar sum, and shortly afterwards others, to the amount of five thousand dollars more. On this Echavaria, who was at once a shrewd and a timorous man, and foresaw the storm that was brewing, endeavoured to prevail on Leita to join him in retiring to Peru with the property they had amassed. But Leita refused to consent; and the result was, that they came to the resolution of dividing their property, and Echavaria made his escape immediately after—having first buried, in a spot near the mill, that portion of his gains which he was not able to carry with him. Shortly after the departure of Echavaria, it was reported that Leita had discovered another mine, still richer than any of those that had been hitherto worked upon. Whether this was true or not, it had the effect of exciting still further the cupidity of the new government, and an order was speedily sent to Leita, requiring him to furnish a still larger contribution. This he had expected, and had prepared himself for, by burying in the ground nearly all his treasures; and his reply to the government order was, that they had already deprived him of all his gains. But they were not to be put off in this manner. On receiving the above reply, they immediately had a meeting of the Cabildo, in the town of Rioja; and the result was the sending a militia officer, and twenty men, to take Leita into custody, and lodge him in prison, under the pretence that he was an old Spaniard, and an enemy to the state. The party arrived at his house, in the Escaleras, just as he was sitting down to dinner; and having immediately taken him, and placed heavy fetters upon his legs, they were about to place him on a horse and carry him away. But he determined on having recourse to stratagem, with the view of, if possible, gaining his liberty, and escaping from their hands. Accordingly, pretending the utmost submission to the commands of the government, he invited the party to take some dinner with him before they set out, and offered to supply them with some excellent wine, which he possessed. This proposal was immediately accepted by the officer commanding the party; and, as the only servant of Leita, a black slave, had ran away on the approach of the military party, Leita offered to wait on them himself, and fetch the wine, serve the dinner, &c. This he did for some time with great apparent good humour, and with great satisfaction to the party; who, as their spirits waxed higher with Leita's excellent wine, grew more favourably disposed towards their prisoner; and the head of them, seeing with what alacrity he went in and out in their service, observed that it was a pity he should be so much inconvenienced by his fetters, and ordered that they should be taken off. Freed from this incumbrance, he still kept running in and out, doing their bidding, and supplying them with more wine; till at length, having ascertained the position and arms of the three centinels who had been placed without, he watched his opportunity and suddenly closed the door (which shut with a spring-latch) on the drinking party within; and then, having by great resolution and strength, disarmed and put to flight the sentinels, he presented himself at the window of the room where the rest were enclosed, and threatened with an axe to chop off the head of the first person who offered to escape by that exit. Then, still keeping watch over the now drunken party within the room, he whistled for his black slave (who, it appeared, had only been sent out of the way to conceal himself, with the view of assisting his master's project). Leita ordered him to prepare the two best horses of the party and bring them to him, and to unsaddle and turn loose all the rest. This being done according to his desire, both master and man mounted, and were soon at a great distance on the road across the Andes to Coquimbo, in Chili. They rode day and night; but by the time they had reached the central ridge of the Andes, their horses sunk under them from fatigue; and, on seeing their pursuers approaching in the distance, they abandoned their horses, and continued their flight on foot, making for the craigs and precipices, where their pursuers could not possibly follow them. They were now safe for the present; and in a few days Leita made his appearance before the Spanish royalist general, Osorio, representing who he was, and the circumstances under which he had left Rioja; and stating that if the general would supply him with a certain number of men, he would engage speedily to reduce the whole province to the dominion of the Spanish monarchy. Osorio could not supply Leita with the required means, but was induced, by his representations, to provide him with letters of recommendation to Pezuela, the viceroy of Peru, who, he said, would be likely to further his view in the proposed project. But to deliver these letters, it was necessary that Leita should travel through a great track of country, in the provinces of Tucuman and Salta, at the imminent risk of falling in with his enemies. He, therefore, determined to disguise himself as a poor miner, and taking only one attendant as a guide on the road he was to go, leaving his own faithful black behind him to avoid suspicion. In this manner he reached in safety the boundary province of Salta. But here observing a scouting party of fifty men in the distance, Leita hid his money and papers in a thicket hard by; which he had scarcely accomplished, when the party came up, and began to make illusory inquiries, which he at first refused to answer, for fear of causing suspicion by his Arragon accent. At last, being compelled, by their ill-usage and threats, to speak, he described himself as a poor miner in search of work. But, as he had feared, his accent excited further suspicions, and they proceeded to beat him and his guide, till the latter at last confessed who Leita was, though he could not disclose the object of his travelling that road. But another blow or two soon induced him to confess where his master had hidden his papers and money; and these disclosed all that they wished to know. They then immediately conducted their prisoner to the city of Tucuman; where he was subjected to a brief and summary trial, and was immediately condemned to death, for being in correspondence with the enemies of the patria. Soon after his condemnation, a priest, named Jose Augustine Colombres, came to confess Leita; and, with the view of extracting from him the knowledge of where he had hidden his supposed treasures, he promised to procure a grant of his life on condition of such disclosure. Leita was easily induced under his desperate circumstances, to fall into this snare; and, having made the desired confession to the wily priest, he was almost immediately shot in the Plaza of the town. Two years after this, the above-named priest made a journey to the Escaleras, for the purpose, as is supposed, of taking away the buried treasure, the knowledge of which he had extracted from its owner; and thus concluded the first modern mining enterprize of the Famatina.

This history was related by a person who was himself intimately connected with the mines then working in the mountain, and who went on to tell me a few further anecdotes relating to them. He said, that having, by dint of hard industry, amassed a little capital, he determined to embark it in the mining speculations, which the success of Leita and Echevaria had brought somewhat more into fashion; and, having exhausted his own savings of two thousand dollars, he borrowed two thousand more, with which he was at length successful, and speedily afterwards accumulated a capital of ten thousand dollars; but that, disgusted by the vexatious obstacles thrown in his way by the new government, he had retired to Cordova with his little fortune, and embarked it in trade. Until this period the mines of the Famatina had been looked upon as open to the enterprises of any body who chose to engage in working them. But when Rivadavia came into power in Buenos Ayres, he determined on turning their wealth to a national account. He, therefore, sent to the governor of Rioja, for a statement of the general state of the mines, and their adaptation to the purposes he had in view, of making them subservient to the interests of the state. The consequence was that a great company was formed at Buenos Ayres, under the auspices of Messrs. Hullett, Brothers, and Co., consisting partly of English and partly of native merchants; and to this company the right of working all the mines in the province of Rioja was conceded, for a certain period, and under settled restrictions.

It may be well to close this sketch by a brief notice of the present, or, at least, the very recent, condition of the mines at Famatina. Some years ago, the number of working miners employed on the mountain was rather less than four hundred, a comparatively insignificant number, when it is considered that the mountain is twenty leagues in length, and that not more than one-fourth of that extent had been, in any way explored for mining purposes, and even that portion had been examined very imperfectly. Indeed, so rude was the method then employed of working the mines, and so inexhaustible are the riches supposed to be which they contain, that, at the time referred to, the miners used to turn away with contempt from any spot which did not contain ore capable of returning six hundred and forty ounces of silver for every *cajon* (about four thousand eight hundred pounds); and many of the mines then in work produced an average of four times that proportion. Moreover, so defective was the system of working the mines, it was perfectly well understood, that the workmen stole at least half the produce. Yet, notwithstanding all these drawbacks, the profits of working the mines were understood to be immense, as compared with the capital employed for the purpose. The wages paid to the workmen, at the period now referred to, was as follows:—To the working miner (*barretero*) twelve dollars per month, and as much beef, bread, and firewood as he chose to consume; to the *apire*, or labourer, who carried up the ore on his back from the lodes, eight dollars per month, and the same provisions; the overseer (*majordomo*) was generally paid from twenty-five to thirty dollars per month, and he generally contrived to appropriate as much more. The mountain was, as it were, parcelled out into nine different divisions; of which the richest and most productive was said to be that portion called the Cerro Megicano, and situated just beneath the snowy ridge. The other portions bearing the best repute for riches, were the Ampallao, the Cerro Negro, and the Cerro Tigre. In the Cerro Majicano alone there are eight rich mines. The particular mine which is reputed to be the richest, is called the mine of Santo Domingo. It produces abundance of virgin silver, and was at that time estimated at the value of two hundred thousand dollars. The metal of nearly all the mines is silver; but there were three or four which produced gold. These, however, though much more healthy to work than the silver mines, were not looked upon as nearly so profitable.

ANTIQUARIAN REMAINS DISCOVERED IN AMERICA.

A grand antiquarian discovery has been made in the far-west, that promises to provide abundant speculation for the learned of every civilized country. Babylon, Balbec, Palmyra, Thebes, and Memphis, present ruins that were once inhabited by people who are well known to us by the records of history. But in the back and beautiful wilds of North America have been recently discovered the ruins of a large half-buried city, of the population of which nothing whatever is known. They were probably a race of men who have entirely passed away from the earth. Certainly the Indians of the present day, and their forefathers never dwelt in cities. I have been much in the wild western regions myself, and have examined the mounds of Missouri and Illinois, and particularly that singular structure, "Monk's Mound." all of which bear evidence of having been constructed by a totally different and more civilized people than any of the (so-called) aboriginal tribes. But here is a city, the discovered parts of which are built with brick. By whom built and by whom peopled, I leave to the learned in archæology, merely remarking that some of the Indian tribes have traditions of another race of men having once lived in North America. They have also traditions of the mammoth having roamed in the forests, "crushing pine trees in his walks, and devouring men and animals for his prey, until the Great Spirit, in a dreadful storm of thunder and lightning killed the mighty beast; since which the red man has fished in the clear waters, and hunted in the forest and on the prairies." It should be stated, that these people were different from the Mexicans, their building being dissimilar. But, as I before said, I leave these, and a hundred other speculations, to the learned in antiquarian research. The first accounts of this discovery appeared about two months since, but they were vague and unsatisfactory, and were not generally believed. Under these circumstances, therefore, I said nothing about the matter in my letters. Yesterday, however, I received an account from a friend, with a copy of the Chicago (Michigan) newspapers, in which there is a drawing of the citadel and some descriptive particulars, by N. F. Hyer, Esq., a respectable surveyor. The editor states, in effect, that the diagram is prepared from actual survey by that gentleman. These ruins form a new and prominent attraction among the many the west affords, and illustrate and confirm some of the strange theories and opinions of scholars in relation to the early character of the western territory. Will the mysteries of its population ever be unveiled? Of a truth, the far-west is rich in wonders, and in all probability, this is only the first in a train of discoveries for future record and admiration. There are many other mounds to the north-west. These ruins are situated in the township of Jefferson, west of Milwaukie, on the west side of the west branch of Little Rock River, about forty-two degrees thirty minutes, north latitude, and longitude twelve degrees thirty minutes about west of Washington. Mr. Hyer says, that a settlement has been recently commenced in the vicinity; the curious, therefore, will be able to pursue their researches without the necessity of "camping out"—no joke, as I can affirm from experience, wherever there are wolves, bears, and panthers. The Indians call this city Aztalan, but why is not stated. This ancient metropolis of a by-gone world has left traces of being some miles in extent; and should any further information transpire on the subject, I will forward it. Although no "Jonathan Oldbuck" myself, I am aware that the discovery possesses a deep interest for the archæological and learned world. The navigation of the Delaware to Philadelphia, the Elk to Baltimore, and the Hudson to Poughkeepsie, is now open, and nearly clear of ice.—*American Paper, March* 1.

The Endless Ladder.—A patent has recently been obtained for a most ingenious and useful machine, adapted to mining and many other purposes, where the main object is to raise or lower weights and packages in constant succession. This simple, but very effectual contrivance, consists of an endless ladder, made either of chain or rope, which passes *over* and *under* two revolving drums or cylinders, mounted upon horizontal axes; one placed at the bottom, and the other at the top, of a shaft or plain, to or from which the ladder is intended to reach. A continuous motion being given to either of the cylinders by the power of steam, or animal force, the endless ropes or chains, furnished with horizontal staves, like those of a common ladder, are made to circulate over the revolving cylinders by which they are extended, so that one part of this endless ladder is continually ascending with a slow but uniform motion from the lowermost of the cylinders to the uppermost, whilst, *vice versa*, the other part of the ladder is descending to the lowermost in an uninterrupted circulation. A vast deal of labour is thus unremittingly performed, with the important result of great economy in time and power. The invention also provides a safe and easy conveyance for men; the accomplishment of which, in a philanthrophic, as well as any other point of view, has long been a desideratum in mining operations. For this purpose, a small moveable step or footboard, furnished with a handrail, is applied, which, if desired, can be made wide enough to admit of several persons standing abreast, who are, by this means, passed up and down without fatigue, and in perfect security. Independently of the certain advantages that would result from the application of such machinery to the purposes for which it appears to us so admirably adapted, we consider Dr. Spurgin, of London, the inventor of this apparatus, to have thus planned a most admirable contrivance for the poor miners, a numerous class of our fellow citizens, who, from the peculiar nature of their occupation, are exposed to fearful risks of life and limb, and whose casualties would be materially diminished by the adoption of this machine.

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The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT---XVIII.

REVIEWS.

The Fourth Annual Report of the Royal Cornwall Polytechnic Society. 1836. Trathan, Falmouth; Simpkin and Marshall, London.

To excite the ingenuity, to draw forth the resources of a large number of individuals, and to direct these qualities into beneficial channels, is an object which forms a prominent feature in numerous associations which have been formed in this country during the last half century. The Society of Arts may justly be regarded as the model of these institutions, nor can too much praise be given to the spirited exertions of this society for public advantage. Situated in the metropolis of the country, and founded on an extensive scale, with means fully adequate to the great objects which it proposed, the Society of Arts has fostered, and most successfully stimulated, the inventive powers which are productive of so much national benefit to our manufactures and commerce, and has also done much to improve the general cultivation of the fine arts, in which, at the period of its formation, England possessed scarcely a trace of her present excellence and proficiency.

It is sufficiently evident, that a plan productive of so much benefit when carried out upon an extensive scale, must be equally advantageous in a smaller sphere, when conducted in a more limited manner by a provincial association, and the truth of this proposition is abundantly proved by the "Polytechnic Society of Cornwall," whose Fourth Annual Report is now before us.

The object of this society is to stimulate the industry and the ingenuity of all classes, by offering suitable premiums for essays on important and practical subjects, mechanical inventions, works of art, &c., &c.; and the present Report is a sufficient proof that this object has been attained in a very considerable degree, while the papers which it contains possess great literary and scientific merit, as the extracts we shall have occasion to make will afford abundant evidence. It also illustrates the great advantages arising from provincial associations of the kind we are considering, in drawing forth talents which might otherwise have been lost, and in directing attention to those objects of local importance which would not fall within the cognizance of a metropolitan society—and of such objects there are abundant examples in Cornwall, and indeed in most of our great mineral districts.

Thus, in the present Report, we find that premiums have been offered for "the best practical method of ascertaining the quantity of water raised by each lift of pumps in the mines of the county;" for "the most complete and accurate accounts of the quantity of water supplied to the boilers, the number of bushels of coal consumed, and the duty performed by any engine for a period of not less than six months;" for "the best chemical or mechanical plans of ventilating mines;" for "the best essay on the diseases incidental to miners"—a subject, the interest and importance of which, can require no comment; for "improvements in facilitating the descent and ascent of miners;" and for "the best practical plans of boilers and expansion-gear, adapted to steam-boats."

By directing specific attention to subjects similar to the preceding, the results being judged of by practical and scientific men residing on the spot, and by the facilities presented by local competition, it is obvious that the "Polytechnic Society of Cornwall" is engaged in the performance of self-appointed duties, which are closely connected with the best interests of the county, and is, therefore, strongly entitled to the consideration, not only of its residents, but also of distant capitalists who may have invested their property in its mines, and have thus identified themselves with the successful exercise of all the talent which can be brought to bear upon these important undertakings.

On turning our attention to the volume before us, merely as a literary or scientific production, we are pleased to observe among its contents, papers which must give it a high value in that respect, and render it deserving of more general notice and wider circulation than as the mere report of a provincial association it would be entitled. The papers to which we allude, are those on "the various diseases of miners, their causes, and the best practical means of remedying them; with statistical information as to their longevity, compared with that of the other population of the county," by Mr. Richard Lanyon—"Observations on the application of expansive steam," by J. S. Enys, Esq.; and a long and elaborate article "on mineral veins," by Robert Were Fox, Esq., containing the fullest explanation we have seen of that gentleman's views on this interesting subject.

This latter article occupies one half of the volume, and, as the committee observe in their report, "might challenge a place in the transactions of any scientific body in the kingdom," although allowed by its author to enhance the value of the work under consideration, by appearing exclusively in its pages.

Mr. Lanyon, in the paper we have referred to, first considers the peculiar evils the miner is exposed to, both by his laborious occupation, and the noxious gases evolved in the mine, which he is compelled to breathe, and the diseases to which he is thus peculiarly liable. It is, however, from the concluding part of his paper that our extracts will be taken, commencing with the following statistical details:—

"In concluding these remarks on diseases and accidents, I have only to observe, that one common train of morbid action generally puts a period to the unfortunate miner's existence, if he live to attain to the age of fifty or sixty years, and continue his underground employment. Very often at the age of forty, if asked, he will acknowledge that his respiration is impeded more or less considerably; and if about his forty-fifth or fiftieth year, he relinquish his underground labours, his life will probably be prolonged many years. Since I have been engaged in this subject, I have met with several men from seventy to even beyond eighty years of age, who had formerly been miners, but who had given up working underground ten, fifteen, or twenty years respectively.

"I exceedingly regret that I had not resolved, at an earlier period of the year, to enter on this work, and that, in consequence, my statistical labours have been very limited, although sufficient to prove the assertion made at the commencement of this essay—'That miners are neither so long-lived nor so healthy as the other *labourers* of the county.' From the predominance of the former over the latter in point of number, I have found it impossible to make them equal from this neighbourhood. The committee, however, will have an opportunity of drawing more correct inferences from the united reports of those who, like myself, have engaged in the inquiry. The number of miners, whose names I have before me, is 240, and that of the other labouring population 120, which last I purposely exerted myself to obtain, that it should be a moiety of the other, in order to make it more easy to observe the differences. They have all been taken, without selection, as they casually presented themselves, and not above five or six are included who have been engaged less than ten years in their several occupations. A striking difference is apparent in taking the average ages of the two classes respectively. The united ages of the 120 will average forty-seven years nine months for each person, and the period they have worked at their various occupations thirty-two years five months. Whereas the sum total of the 240 miners will only give thirty-eight years two months for each individual's life, and twenty-two years ten months in which they have severally been engaged in mining operations. The following table will show the other results of the inquiry:—

MINERS, 240.

Above 30 years of age	172
— 40 ditto	94
— 45 ditto	57
— 50 ditto	29
— 55 ditto	17
— 60 ditto	8
— 65 ditto	*2
— 70 ditto	None
* One of these was a sailor till the age of	32
Of the 240, there are who always or occasionally labour under some disease	89
Of which there are who have cough, dyspnœa, palpitation or all of them	67
Dyspepsia....................	17
Rheumatism	13
Other diseases.................	8

LABOURERS, 120.

Above 30 years of age	93
— 40 ditto	68
— 45 ditto	63
— 50 ditto	57
— 55 ditto	48
— 60 ditto	35
— 65 ditto	27
— 70 ditto	14
— 75 ditto	8
Of the 120, there are who always or occasionally labour under some disease	17
Cough, dyspnœa................	*9
Dyspepsia....................	2
Rheumatism	3
Other diseases.................	10

* Two of these contracted their diseases from working underground previously.

"It will be seen from the above that the more aged labourers are infinitely more healthy than the miners, though their ages average almost ten years more. And, also, that not above one-eighth of the miners have attained the age of fifty; whilst one-half, or nearly so, of the 120 labourers have completed their fiftieth year, or gone beyond it.

"The period intervening between the ages of forty and fifty, is evidently a most fatal one to miners; and if at this time they unhappily neglect the opportunity of preserving their health by ceasing to work underground, dyspnœa and cough become established, and progressively aggravated by their occupations. To these are often added palpitations, succeeded by dropsical effusions, but in most cases by debility and emaciation; and they at last sink under the combined effects of chronic bronchitis and its sequelæ, united to a diseased heart. This, I believe, is the most rational hypothesis of the pathognomonic state of the disease called 'miners' consumption.' Tubercles no doubt exist in some cases, but true tubercular pthisis of an hereditary source occurs and terminates fatally, more frequently before thirty than after; but the affection under consideration commences generally after forty, and proceeds slowly for many years, exhibiting the symptoms of severe chronic bronchitis, aggravated, I conceive, by dilatation of one or more of the cavities of the heart. Whether any other peculiarly diseased state occurs, as some have supposed, I have had no opportunity of determining by dissection, and little practical good, I fear, would result, even if we knew that such were the case; but my opinion is that none such exists."

The practical remedial measures suggested by Mr. Lanyon, are well deserving of consideration, as resulting from an intimate local acquaintance with the subject on which he treats. This important topic occupies the remainder of his paper, which we shall now extract:—

"I have been encouraged by some remarks which Dr. Carlyon has made on the subject of diet, to attempt to direct the attention of the public to an evil which I have long considered to be of great magnitude. The difficulties which surrounded it, I feared, were insurmountable, but supported, as it now is, by such an authority, I sincerely hope that some plan, feasible enough to merit notice, may be introduced; by means of which the miner, after the toil of his labours, his sufferings from working in poor air, and exhaustion from climbing the ladders, might be furnished with a small quantity of plain and wholesome food to recruit his depressed energies, and to enable him to undertake the additional labour of walking to his home, which is very often a distant one, and, as Dr. C. has most feelingly depicted it, seldom calculated to afford him comfort, or the necessaries of which he stands so much in need, fraught as it is with the wretched consequences of an early and improvident marriage. Knowing that whatever is proposed, must be both easy of attainment and cheap, to insure regard; it has occurred to me that it might be thus done:—

"A small house fitted up on the mine, with the necessary conveniences, at the cost of the adventurers, might be let or lent to some industrious family, who should undertake to furnish to every miner (working underground) half a pound or one pound of hot tea, coffee, soup, or gruel, once in twenty-four hours; to assist in paying for which, 1d. or 2d. might be deducted monthly, in the same way as the club-money, &c. are paid, and the deficiency supplied by the club, which in many mines is so rich as to be well able to defray the whole expense.

"An establishment of this kind would not only serve this purpose, but, by extending the sphere of its action, would be capable of effecting another object, which I have long thought to be of still greater importance.

"The diet of miners generally, I am quite sure, is totally insufficient to compensate for the wear and tear of their severe and peculiarly destructive labours; and this does not always depend on poverty, but to a want of economy and management in the disposition of their earnings. The wife has little or no acquaintance with household duties, having left the cobbing shed, where the whole of her life has been spent, to become at once the provider and manager of a domestic establishment. It will not be wondered at, then, with an education so unsuitable to such duties, that the husband should seldom have the comforts, and not often the necessaries, of his life provided for him. He leaves a cheerless home to follow his disagreeable and dangerous calling; supplied with food of the meanest and most indigestible kind, which generally consists of a piece of baked dough, mixed with little of any thing else, technically termed a 'hoggan,' and this is supposed to be adequate to his support. Much mischief was formerly produced by men disregarding the precaution of taking food underground with them; but this, I believe, is now seldom neglected, as it was frequently the occasion of inducing stomachic affections of a very troublesome character. Food, such as I have described, will certainly answer the purpose of appeasing the feelings of hunger, which arise from working long cores or stems, on the same principle as some savages I have read of eat clay; but it is not capable of yielding much more nutriment; and if there were no other cause, this would be sufficient to account for the prevalence of stomachic complaints, as exhibited in the foregoing table.

"It is to remedy this state of things, to fit the miner for his laborious duties, and to enable him to withstand the noxious influences to which his calling exposes him, that my propositions are intended. To convert the establishment just named into an eating-house, is what I beg to suggest, and thus to furnish to the men food, particularly animal, at a cheaper rate than it would be possible for them to get in any other way.

"But how, it will be asked, is this to be done? I answer, by such an endowment from the club or adventurers as will give the men the privilege of obtaining animal food, cheese, &c., at half the current price at which they are sold. Thus, a slice of dressed meat, which will cost him perhaps 2d., with a couple of slices of bread, which, to save expense, he may bring from home, might provide for the miner every day such a meal as many of them do not eat once a week. To insure the well-working of this system—to encourage economy—and to attempt the suppression of beer shops, instant payment should be insisted on for the articles received. Would the interest of the De Dunstanville fund be large enough to promote this object?—subscribed, as it has been, solely for the use, and to improve the present physical condition of the miner. I know of no method which would render it more available to their wants, if sufficiently large. A proposal from the committee to divide the interest of the money subscribed, or which may hereafter be subscribed, in aid of this cause, among those Cornish mines in which an institution of this sort may be established, prior to a certain period yearly fixed on, and in the ratio of the number of men employed underground, would most likely be the means of calling one into existence in every large mine in the county. This sum, whether small or great, would be united to, and employed in the same manner as the other endowments. Nothing but a firm conviction that our miners are materially injured by a want of nutritive food, and that, circumstanced as they are, in nine cases out of ten, they cannot possibly obtain that of which they stand so much in need, would have led me into these, which some may consider tedious and useless details; but so impressed am I with their truth and force, that they are to me both interesting and important, so much so, as to induce me to believe that some such method would do more to improve the condition of the miner, than any thing else with which I am acquainted.

"In closing these imperfect remarks, I would observe, that as it is apparent that the period which intervenes between the forty-fifth and fifty-fifth year of the miner's life, is an extremely fatal one, if he continue to work underground; every effort should be made by agents of mines to induce men of this age to relinquish their underground occupations, by offering them situations at the surface, many of which are now filled by young and able-bodied men, although the duties might be as well performed by persons of this class."

These suggestions we recommend to that consideration which they will doubtless receive, and express our earnest hope that every possible amelioration will be made in the condition of the deserving class to whose welfare they are devoted. The subject is far too important, and has too great a claim on our attention, to be passed over with a slight or hasty comment; we shall, therefore, shortly return to it again at greater length, congratulating the Cornwall Polytechnic Society on having elicited the interesting communication of Mr. Lanyon in their present, and of Dr. Carlyon in their preceding Report—communications which we hope will be made the basis of essential benefit to the working miner, not only in Cornwall, but in other parts of England also.

The use of the single-acting engine for stamping, is a recent improvement of considerable importance as regards economy, and appears to be attended with the most complete success. We shall, therefore, extract the passages in Mr. Eny's paper describing the application of this principle at Wheal Kitty and the Charlestown mines:—

"Two stamping engines have been erected by Mr. James Sims, one at the Charlestown mines, the other at Wheal Kitty, expressly arranged for expansion; a plan probably suggested by the improved duty which attended his introduction of it, in an old double-acting engine at Poldice; it has also been tried at Binner Downs: the cylinders are thirty-two inches in diameter, stroke nine feet; consequently, the ratio of length to diameter, 3.37, is greater than usual; the cogged wheels introduced to diminish the revolutions of the barrel, as compared with the crank, have been omitted.

"This gearing was probably adopted, in the first instance, in the conversion of a whim-engine of power insufficient for stamping, and the plan has been followed, though more freedom is allowed in the dimension of cylinders in those places where an engine's merits are judged by a reference to work done per bushel of coal, instead of horse-power; these engines are single acting, with a heavy balance connecting-rod, and two fly-wheels, and use steam about 22 lbs. per square inch, on the safety valve, or about 36 lbs. pressure, expanding two or three times in the cylinder. The stamps, about seventy, are arranged in equal numbers on each side, and are lifted by a barrel directly attached to the crank—their average lift is nine inches, three inches out of the twelve to which they are set to rise being allowed for the ore beneath them—their weight can be ascertained and checked at any time for calculations for duty.

"The average performance has been:—

				Duty.	
Sim's engines	Charlestown mines..	12 months	....	45,677,347	Lbs. 1 foot high per bushel of coal.
	Wheal Kitty	6 ditto	to Dec. 1836	50,606,042	
	Ballaswidden	12 ditto	....	18,685,278	
	Wheal Vor	6 ditto	....	21,326,144	

"An improvement amounting to a saving of fifty or sixty per cent. of coal.

"The average at Wheal Kitty includes the December report of thirty-six millions, the highest was fifty-five millions."

The important results which have attended the investigations of Mr. Fox in the mines of Cornwall, must be well known to our readers. Their progressively increasing temperature in depth, as depending on other than local and accidental causes, was first firmly established by this gentleman's experiments; the existence of electro-magnetic currents in mineral veins was first ascertained by him, and we have in the volume before us a full exposition of his views of the mode in which this class of metalliferous deposits was originally formed.

It will be in the recollection of our readers, that these views were made public, for the first time, we believe, in a lecture delivered by Mr. Fox about six months ago, at Redruth, and of this lecture a copious notice was given in our Journal of that date; we shall, therefore, briefly observe, that he considers mineral veins to have been originally narrow fissures, in some cases progressively opened to a greater width at subsequent periods. These fissures he conceives to have been filled with saline solutions of mineral and metallic substances, and that they were separated from this state of solution by the action of electro-chemical agency.

Such are the leading points of Mr. Fox's theory, on which we do not propose on the present occasion to offer any comment, and for further information we must refer the reader to the Report itself, considering that it would be unfair to extract any portion of a paper which confessedly forms its most valuable and most prominent feature as a work of general interest.

First Russian Railroad, from St. Petersburgh to Zarscoe-Selo and Pawlowsk, established by Imperial Decree of 21st March, 1836, and carried into execution by a Company of Shareholders in Russia, England, and Germany. Translated from the German. St. Petersburg, 1837. Skipper & East, St. Dunstan's-hill, London.

[Second notice.]

In our former notice of this pamphlet we gave a brief history of the origin of the railway now forming, and indeed nearly completed, from St. Petersburg to Zarscoe-Selo and Pawlowsk, being the first work of the kind in the Russian empire, and probably only the precursor of others of far greater extent and commercial importance. We pointed out the extraordinary privileges with which the company was endowed, and the spirited mode in which the undertaking was commenced and carried on, under difficulties of some magnitude as regards the supply of the necessary materials and machinery.

We now return to the work, chiefly for the sake of making such

extracts as are likely to prove interesting to our readers, as showing the spirit and activity which prevails in that vast empire, which, both politically and commercially, must be an object of no inconsiderable interest to all the other nations of Europe, and of whose advances in the development of her mineral wealth, we lately furnished a notice of considerable length. We shall first quote the introductory pages, omitting merely some tabular statements, as being of secondary importance:—

"The reports on the Zarscoe-Selo Railroad, which from time to time have appeared in the Russian papers, and from thence have been copied into the foreign journals, have excited considerable interest in the public, particularly in Germany and England. No undertaking of the same class has hitherto made such rapid progress as this railway, which, called into existence by the especial patronage of the Emperor of Russia, and endowed with most extensive privileges, precludes all doubt of its proving eminently successful and advantageous to the shareholders. In a few days subsequent to the Imperial Grant being obtained, the company of shareholders was formed, and the whole capital (three millions of rubles) subscribed. The payments of the calls upon all the shares issued, were made with punctuality, and no single instalment remained in arrear. Within six months and six days from the time the decree received the imperial sign-manual, the requisite supply of rails and materials, carriages and machinery, was obtained from England; most of the works on the entire length of line, twenty-five and a half wersts, were completed, the rails partly laid down, and three wersts opened by horse power. Six weeks later the opening of a distance of seven and a half wersts, with locomotives, took place; and this summer (1837) the whole of the line, from the centre of the capital to the terminus in Pawlowsk, will be opened.

"This rapid progress of the undertaking, which in other countries would have been the work of several years, naturally excited the attention both of natives and foreigners.

"That portion of the English public which takes a general interest in railways, expressed a desire to obtain the reports which have hitherto appeared, that they might be enabled to investigate the circumstances that led to so extraordinary a result in Russia; another portion, better acquainted with the favourable state of the Russian share market, with a view to partake in this new speculation:—but as the publications of the Chevalier von Gerstner—viz.:—

"*Memoir on the advantages of a Railroad from St. Petersburg to Zarscoe-Selo and Pawlowsk, 20th March*, 1836;

"*First report on the progress of this Railroad, 20th July*, 1836;

"*Second report on the same, 22nd September*, 1836; have for some time been out of print, the

"*Third report, 29th January*, 1837, which has reference to the preceding, would hardly be understood by many readers. The purport of the present paper is, therefore, to lay before the public in this country a clear statement of facts relative to the Zarscoe-Selo railway, to assist them in forming a correct opinion of the enterprize, and in entering into it, as well as into other manufacturing concerns about to be carried into effect in Russia. It will tend, at the same time, to give a more expanded view of the internal constitution of that colossal empire, and to correct the erroneous opinions that have been induced by a defective knowledge of its actual condition.'

"PETER the Great, the immortal founder of the power and greatness of the Russian empire, felt how necessary to its welfare was the improvement of its communications; he had witnessed in Holland the beneficial influence of canal traffic; he visited the interior of his empire, and himself planned the whole of the water communications which were, either during his reign or afterwards, carried into execution. This Sovereign introduced *Canals* because, in the then existing state of knowledge, they were considered as the most perfect channels of internal communication. ALEXANDER I. introduced artificial *Roads*. He commenced with the first turnpike road from St. Petersburg to Moscow, a distance of about 700 wersts, the smallest portion of which only was accomplished when death overtook this monarch; but his successor, the reigning Emperor NICHOLAS I., carried out the project; in a few years finished the road to Moscow; and caused surveys to be made for a complete system of roads, intended to intersect the whole interior of the empire, which, under his happy reign, is now making such rapid advances in prosperity.

"The progress which *Railroads* had made in modern times did not escape the scrutinizing view of the Sovereign. The Chevalier von Gerstner went to Russia in August, 1834, with the intention of visiting the interior of the country, and informing himself respecting its manufactories and mines. The Emperor NICHOLAS heard of this, as well as that so early as 7th September, 1824, the Chevalier had obtained a privilege from the late Emperor FRANCIS of Austria, to construct a railroad between the Moldau and Danube; that for four years, up to 1828, he conducted the works on this line, comprising, with its continuation from Linz to Gmunden, a total length of 130 English miles, over which the traffic continues in summer and winter without interruption. The Emperor in consequence, in September, 1834, expressed a desire to see a line of railway from St. Petersburg to Moscow executed, if possible, by a company of shareholders.

"After the Chevalier von Gerstner had, in the beginning of 1835, finished his tour to the manufacturing provinces, he was presented at the Court of St. Petersburg, when the Emperor, with great earnestness, and with the penetration for which he is so remarkable, expressed himself strongly as to the advantages that would result from the introduction of railways into Russia, and the extraordinary privileges that the first undertakers might expect.

"The Chevalier von Gerstner in consequence proposed to commence with two short lines, the first from the interior of St. Petersburg to the towns of Zarscoe-Selo and Pawlowsk, and the second from the same point in the capital to Peterhoff and Oranienbaum.

"The negociations for the grant lasted to the end of the year 1835, when, on the 21st December, the President of the Council, in the name of the Emperor, communicated to M. von Gerstner that he was thenceforth invested with the *exclusive personal privilege of incorporating shareholders for the execution of both railways*.

"The Chevalier von Gerstner hereupon joined the three other directors and founders of the company of shareholders, whose names have been given above, for the execution of the first line, from St. Petersburg to Zarscoe-Selo and Pawlowsk, whilst he reserves to himself the right of forming the company for the line to Peterhoff.

"The demand for shares, on the undertaking of the enterprize being made public, was so great that the first 15,000 shares, or the original capital of three millions rubles, were subscribed for almost immediately; chiefly by the Russians and naturalized Germans, although persons residing abroad may participate, without any restriction. The latter may either appear in person at the general meetings, or be represented by their agents, and receive their dividends the same as the Russian subjects, without any deductions or the payment of any duties to the state.

"The Imperial Grant for the Zarscoe-Selo railway is dated 21st March, 1836. The privileges thereby conceded to the company are very considerable, such as were never granted to any railway company in any country before. The execution of the railway is regarded as if undertaken immediately by the Crown; the Crown lands have been gratuitously ceded to the company; the farmers holding lands that were required, have been appointed to other ground, and are compensated by the Crown for any loss sustained by the transfer; lands or buildings, the property of private individuals, must be surrendered to the company, either by voluntary agreement or at a price to be determined by judicial valuation; but to prevent the obstruction of the works, the company, by depositing a sum of money about equal to the purchase price of a similar plot of ground or tenement in the vicinity, have the power to take possession of such lands or tenements before the termination of the appraisement. The valuation being determined, the balance of the amount due is paid to, or received from, the parties.

"The company are at liberty to erect any description of buildings requisite for the railway traffic, for 100 fathoms on each side of the railway, except in the Artillery Ground, through which the line passes, and for the acquisition of which the same privileges have been granted as for that of the rest of the line. The removal of the battery, rocket manufactory, and other military buildings intersected by the line, is to be effected by the company, at their cost, to another quarter. In this manner the railway without the town forms an uninterrupted straight line for twenty-four wersts. Within the town the straight line is only warped into two gentle curves, by following the course of the Wedenskoi canal.

"The medium rise of the whole line is one in 1028, and the extreme one in 504. The railway terminus in the town is at the junction of the Wedenskoi with the Fontanka canal, on a piece of ground eighty fathoms by forty-two and a half in breadth, which has partly been purchased and partly ceded by the Crown. From this spot to the new boundary of the town on the Ligofka, the railway measures about one and a half mile, and will, therefore, for that distance, *run within the capital*, a circumstance of the utmost importance, as affecting the number of passengers or the amount of traffic. The terminus at the other end is situated 550 fathoms within the Great Park of Pawlowsk, the property of his Imperial Highness the Grand Duke Michael Pawlowitsch. The company have been permitted to erect, in some of the finest parts of that park, several buildings for the reception and entertainment of the public; and at Zarscoe-Selo they have been allowed to establish an hotel at the railway station.

"The company have the right to purchase the iron for the whole line, abroad, and to import the same *duty free*, provided no Russian iron work should undertake the delivery in the required quality, form, and time, and at most at fifteen per cent. advance upon the price at which the iron might be imported into St. Petersburg, from foreign countries. The company are farther empowered to import the locomotive engines, railway carriages, and all other machinery and requirements, *duty free*.

"The company are not bound to any fixed fares for the conveyance of passengers, or rates for the carriage of goods, but are at liberty to fix them at discretion. The railway remains *for ever* the property of the company; during the first ten years no one can make a railroad in the same direction; and during the same term of ten years the company are exempted from the payment of rates and taxes of every description, either to the Post Administration or any other authority. The capital of the company is covered by 15,000 shares of 200 bank note rubles each; if necessary, 2500 more shares may be issued for raising the reserve fund of 500,000 rubles; all the 17,500 shares, however, participate alike in the profits of the undertaking. *The number of shares can in no case be augmented.*

"Eight days after the grant had been made out, the Chevalier set out from St. Petersburg for England and Belgium, for the purpose of ordering the necessary rails, engines, carriages, and other railway machinery, as no one could be found in Russia to contract for these materials in the stipulated time.

"It was exceedingly difficult to obtain them in England last year, as the iron works there, in consequence of the many English and American orders, were occupied literally night and day, and most of them had employment for a year or two in advance, in consequence of which the price of rail bars had been raised upwards of forty per cent. within a twelvemonth. Another difficulty arose from the Chevalier having altered the *Gage* (or the distance of the two rails upon which the carriages run) of the Russian railroad, from that established in England. On the old English railroads only goods of small bulk and great weight were transported, such as iron, coals, stones, bricks, &c., but not sheep's wool, hay, straw, or fire-wood. In 1822, when the railway between Stockton and Darlington was begun, which was first intended for a general traffic of passengers and goods, Mr. George Stephenson, the engineer, established the breadth of the track between the rail at four feet eight and a half inches English, as being the width of the track of carriage-wheels on high roads. Experience has shown how inconvenient this arrangement is for the locomotive engines, which in England, usually of thirty to thirty-five horses' power, are by this narrow gage confined within about four feet, which is by far too little for such an engine. The driving wheel can at most have but a diameter of five feet, as otherwise it would lurch too much; in order, therefore, to do thirty miles an hour, it must make 168 revolutions in a minute. The strain and wear and tear of all the parts of a locomotive, by reason of the quick motion of the driving wheel, and more particularly the cramped arrangement of the individual parts, are therefore very considerable.

"The disbursements in the coaching and carrying departments on the Liverpool and Manchester Railway, upon an average of the last three years, amounted to forty-four per cent., and the repairs of the locomotives to fifty-six per cent. of the total expenditure, originating in their wear and tear as a tractive power. This charge must naturally be far less in a wider gage. If cattle and bulky materials, such as sheeps' wool, straw, hay, fire-wood, travelling carriages, &c., are to be conveyed, the load cannot be stowed between the wheels, if the gage is only four feet eight and a half inches, but must be placed in a box or on a platform six to eight feet wide, by which, the base being only half as large as the superstructure, great lurching is necessarily occasioned, particularly at high velocities; and moreover, especially in rough weather, high loaded waggons, with a confined base, are apt to have the flange of the wheels rub up against the rails, thereby occasioning great increase of friction, wear and tear. The trains generally run the distance between Manchester and Liverpool in one and a quarter to one and a half hour, whereas in a high wind those laden with cotton wool take three hours for the journey, which would not be the case if a wider gage had been adopted. Increase of axle friction cannot take place on a wider gage, as in all railway carriages the friction is now no longer between the wheels, but on the outside, on the projection of the axle through the wheel.

"These and other reasons induced the Chevalier von Gerstner to *adopt a gage of six feet English between the rails*; but the consequence was, that for the locomotive engines, turnplates, and machinery, new drawings and models had to be prepared, before the construction of the machinery could be commenced. The deliveries thereof last year were in consequence attended with considerable difficulty; but connexions of many years standing, which the Chevalier von Gerstner had in England, enabled him to overcome these difficulties, and in the Third Report there occurs an account of the rails, chairs, &c. imported duty free into Petersburg."

Passing over some details of the work, and the partial opening of the railway, from which it appears that it progressed satisfactorily, and that the snow occasioned no impediment on the line, we come to the following extract from the Chevalier von Gerstner's third report:—

"Whoever will bear in mind that the Imperial Decree was dated on the 21st March, 1836—that until then I could not take my departure for Belgium and England, for the purpose of giving the orders in those countries for the railway materials—that these orders came when the English manufactories and iron works were occupied night and day, to the utmost stretch of their capabilities; whoever will bear in mind that the gage of the English railways is fifty-six and a half inches, whilst ours is seventy-two inches, and therefore, that not a locomotive, not a carriage or a turntable could be purchased and imported that had not to be planned and have new models expressly made for it, after which, and not until then, the various machinery could be put in hand and made; whoever will further consider that every rail and piece of machinery, when finished, had to be conveyed to some sea port town, there to be shipped for Cronstadt; on its arrival there, to be transhipped into lighters, to be brought on the Fontanka canal to St. Petersburg, again unloaded, and, frequently on the worst of cross roads and marshes, carried to the point of their destination on the railway, there to be laid down and adjusted or fitted up; whoever will calmly examine and weigh all these matters, will not withhold from the direction of the railway of which I have the honour to be a member, the testimony that nothing but the greatest ardour and spirit, systematic management and punctuality, especially in the payments, could, in so short a time, have brought about a result which, in other countries, it generally takes years to achieve.

"As by the arrangement which the directors concluded with me in the name and on behalf of the company, and by virtue of section 10 of the Imperial Ordonnance, the works were committed to my management under certain conditions, involving great responsibility, I lost no time in applying all my energies to the promotion of this great undertaking.

"Although I personally directed the works along the entire line, and traversed it continually on foot from St. Petersburg to Pawlowsk and back again, I nevertheless thought it right to employ seventeen engineers, five of whom had visited the railways in England, as superintendents; besides these, upwards of thirty inspectors, and as many watchmen and soldiers were periodically present on the line. For erecting the machinery and as enginemen for the locomotives, ten Englishmen and two Belgians came over—of the former five have returned.

"Solidity of materials and accuracy of workmanship,—strict integrity in all money transactions,—the greatest publicity in the accounts,—indefatigable attention to the progress of the undertaking,—system and order in the management, were the points I kept in view from the moment in which I commenced this enterprize. By the observance of them I have brought the work, so far as regards my own department, to its present state; by similar conduct I shall bring it to an honourable issue. Russians, Germans, Englishmen, Italians and Belgians co-operated in our undertaking, and a stranger might not unreasonably have been astonished when, on the point of the line, at the building at Pawlowsk he heard five languages spoken and found the people of five different nations here, at so distant a point of Europe, united for one purpose—the promotion of our great object.

"I consider it my duty to state, and do so with pleasure, that the Russian population, so far from throwing obstacles in our way, have invariably been anxious to assist in the execution of the work.

"Incredible as it may appear to my foreign readers, I can state as a fact that no opposition has been evinced (as has almost invariably been the case in other countries) to so great an innovation. The proof is easily adduced, for not a single complaint of premeditated obstruction has come before the authorities. Our difficulties hitherto have been confined to the negociations with the proprietors of the plot of ground between the Ligofka and Fontanka, being town lands; without the town the farmers freely ceded their lands; on the first intimation being given to them by the surveyors, they cleared their forests to the width of sixty fathoms—nay, they mowed the half ripe corn in their fields, in confident reliance that the compensation the law has awarded them would be duly paid. The peasantry from the whole surrounding country worked on the line; and they were the first, who upon its opening crowded into our railway office, there paid their forty kopeks for a seat, and availed themselves of the new conveyance. The coachmen and hackneymen at Zarscoe Selo and Pawlowsk, immediately perceived the prospect of gain which was opened to them; the former arguing the increase of their business in the conveyance of such a number of persons to the stations, and the latter that they will have to accommodate crowds of visitors whom the company's buildings will be insufficient to contain."

Our concluding extract will furnish some account of the object of the Zarscoe-Selo Railway, and the estimated amount of traffic and of profit to the shareholders:—

"St. Petersburg, the modern capital of the Russian empire, was founded by Peter the Great in 1703, at the entrance of the Neva into the Gulf of Finland, in a low, and formerly quite a marshy country. However advantageous this site may be for trade, it has been attended with incalculable disadvantages; amongst which may be reckoned the periodical inundations, of which the 7th November, 1824, afforded so dreadful an example; the changeable state of the weather and temperature, the fogs which envelope the town, the difficulty of constructing sewers for carrying off the impurities from the streets, and of laying down pipes for spring water. The canals which intersect the town are no doubt of importance for the conveyance of fuel and building materials to the town; but they likewise serve as receptacles for filth, and in the heat of summer fill the air with offensive effluvia. The sewers of the principal streets, for want of sufficient fall are at intervals obliged to be opened, and the contents laid in the streets and carted away.

"The consequence is, that the exhalations, especially in warm weather, are very unwholesome, and hence the urgent necessity that the inhabitants of St. Petersburg should, at that season, leave town to reside in the country.

"Hitherto the country houses have been confined to the adjacent islands, elevated only a few feet above the Neva, and in spring and autumn, therefore, covered with fogs. These islands, nevertheless, were generally filled with temporary residents, and country houses continued to spring up in the immediate vicinity of Petersburg. The cheerful town of Zarscoe-Selo is sixteen English miles from St. Petersburg, situated on an eminence bordered by the Neva. The imperial palace there is 220 feet higher than the Neva; the town of Pawlowsk, two and a quarter English miles further, lies 105 above the Neva. The charming situation of these two places, and of the imperial parks adjoining, are sufficiently acknowledged and admired; but owing to the distance from the capital, not above 300 families could annually reside there in summer. Notwithstanding the distance, however, both were much frequented on Sundays.

"For a conveyance to Zarscoe or Pawlowsk, 18s. to 22s. sterling is paid; for a place in the stage coach three and a half rubles, and as much back; nevertheless from inquiries instituted by government in 1834, the number of equipages passing from St. Petersburg to Zarscoe-Selo and Pawlowsk and back again, for one year, was 70,386, employing 178,187 horses. At the rate of one passenger for each horse, the present annual transit of persons would thus be 178,187, of whom half or 89,093 make the journey there and as many back. This great traffic may be attributed to the delightful situations of the towns, as well as to the circumstance that in Zarscoe-Selo and Pawlowsk five regiments, with 300 officers, are stationed, including the two depôt regiments, one of infantry, and one of cavalry, the officers of which change every year or two, as they only learn the routine of duty here, and then return to their stations in the interior of the empire; the traffic therefore on the part of the officers is the same, winter and summer.

"From the perfect construction of this railway, sixteen miles of the line being straight, with a medium rise of one in 1028 the whole journey to Zarscoe-Selo will be performed in thirty-five minutes, and to Pawlowsk in forty minutes. Both places will therefore be converted into suburbs of St. Petersburg, as the time alone fixes the distance. If a passenger is forwarded by the railway for about one and a half rubles, there can be no doubt that as the line runs one and a half miles from the Ligofka to the Fontanka Canal in the interior of the town, a great traffic may be calculated upon.

"In Belgium the railways commence without the towns; in order therefore, to get from Brussels to Malines, it is necessary to ride in an omnibus from the interior of the town to the railway station without, and there await the starting of the train, which occupies thirty or forty minutes arrives at the Malines station; but that being also without the town, it is necessary to get into another omnibus to drive into the town, and in this manner as much time is taken up as by the journey on the railway itself.

"On the St. Petersburg railroad the starting place is nearly in the centre of the city, and it penetrates into the heart of the park of Pawlowsk, where the buildings for the reception of the public, stand. As on the railway from Brussels by Malines to Antwerp, upwards of 100,000 passengers pass monthly, and as is well known not one-fourth of them travel on business, the rest for pleasure and recreation, a very considerable traffic must also be expected on the Petersburg line. Nevertheless the Chevalier von Gerstner took in his first estimate of 20th March last year, the number of passengers who would annually travel to Zarscoe-Selo and Pawlowsk and back again, only at 300,000.

"The population of St. Petersburg, Zarscoe-Selo, and Pawlowsk, amounts to half a million; that of Brussels, Malines, and Antwerp, is not half so much; there we have 1,200,000 travellers annually, here we only calculate upon 600,000, who are to make the journey once; or, in proportion to the population, only one-fourth part of the passengers on the Belgian lines. At this rate, supposing the whole 17,500 shares were issued, there would result a net profit of eleven per cent. to the holders."

The remaining portion of the work treats of a proposed extension of the railway to Ischora, the first station on the road to Moscow, being a preparatory measure to a railway connecting the modern with the ancient capital of Russia—certainly a most gigantic undertaking. It also contains certain terms on which the Chevalier von Gerstner offers to farm the Zarscoe-Selo Railway for three years—a proposition showing the strong confidence he entertains in the remunerative results which will arise from it.

The Railway Magazine and Annals of Science. No. XV. New Series. May, 1837. Wyld, Charing-cross.

In the present Number of the "Railway Magazine," we observe a smaller proportion of original matter than in some which have preceded it, but its place is supplied by information scarcely less valuable to the engineer. The elaborate researches of the French mathematicians on practical subjects, are well known, and two translated articles of this kind are introduced to us in the present Number —"On the fuel of steam-engines," by M. Cordier;—and a memoir "On the calculation of high-pressure steam-engines," by M. Pambour; both papers which have been read before the Academy of Sciences at Paris.

The correspondence of Mr. Herapath with the Royal Society—or rather certain members of it—which appears to have ended in the resignation of Sir Humphrey Davy, will be read with interest, although we feel some regret, after such a lapse of time, at seeing a subject revived which may not be altogether creditable to that distinguished philosopher.

STEAM TRAVELLING TO RUSSIA.—A tour from this country to St. Petersburg might, by the aid of the powerful and commodious steamers of the General Steam-Navigation Company from London to Hamburg, and the very excellent boats of the Emperor Nicholas upon the Baltic, be accomplished in a very few days, but that the short space between Lubeck and Hamburg, the only piece of land upon the way, is almost wholly impassable. The country belongs to the King of Denmark, as Duke of Holstein, and it appears to be the ambition of that monarch to render the duchy super-eminent for its detestable roads in all directions; certainly none so bad are to be met with in other parts of Europe. There has been long an impatience amongst the enterprising and wealthy merchants and inhabitants of Hamburg to open a communication by railroad across these few miles, but all their applications have been received distastefully by the King of Denmark, who wishes to lead the road to Kiel, which is in his own dominions. Lubeck, the more direct way, brings a free city, but that route is not convenient, and the Hamburgers will not engage in it. Throughout the whole of last year the greatest efforts were made to overcome the King's repugnance, and even the Russian government, which has a manifest interest in opening the course, has interfered, but it would seem to be but to little purpose. The last accounts upon this subject in the German papers, which is of great interest to commerce, as the whole navigation of the Sound, and its great expenses, might be saved, which by the way would be a serious loss to the King, show that his Majesty still persists in leading the intercourse through Kiel. We learn from Copenhagen, that on the proposition of a royal commission, charged to examine the possibility of establishing a railroad to unite the Baltic to the Elbe, the King of Denmark has decided that two lines from Altona to Kiel, and from Kiel to Newstadt, shall be levelled. The government has not the intention of constructing the railroads at the public expense, but merely orders the preparatory works; so that, with a knowledge of the facts, they may the better appreciate any proposals which may be made by private companies. The levelling is to commence immediately after the terminations of the harvest, and will be finished in the course of next year.

STEAM-NAVIGATION.—A direct and regular communication by steamboats is now established between Stockholm and Tarnea—the most northerly point of Sweden.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. X.

ON THE USE OF POWDER MIXED WITH SAWDUST FOR BLASTING.

In our "Foreign Extracts" for the present week, we resume a subject previously treated of—the advantage of using a mixture of sawdust and gunpowder in blasting. The following paper contains an account of several experiments made with this mixture, and is further interesting, as showing that under certain circumstances at least, the anticipated evils arising from the combustion of the sawdust in vitiating the atmosphere of the mine, do not take place. We hope this will be an encouragement to further experiments in our own mines, as it is difficult to conceive that a method described as so successful in Germany, should not be equally successful here.

The destructive effects of Congreve rockets are said to be owing, in a great measure, to the employment of powder mixed with sawdust in their manufacture. It is also asserted, that the sawdust is not used in a raw state for this purpose, but boiled in a fluid, which renders it more inflammable, and afterwards perfectly dried before it is made use of. How far the boiling may tend to augment the effect of the powder, deserves to be investigated in a theoretical point of view; and, besides this, the subject is one of very peculiar interest to the practical miner, since the expense of powder, in mining operations, is often very considerable, and, consequently, the saving of powder would be a matter of great importance. The German *General Intelligencer*, for 1817, contains the information, that for a long period the powder of the root *jatropha manihot* has been used in Brazil with advantage, for the purpose of mixing the gunpowder used in blasting. Subsequently common sawdust, from soft kinds of wood, was also employed, and found to be even more effective than the powder above-mentioned. It would be interesting to know how this discovery was made in Brazil, and to rescue from oblivion the fortunate incident which led to it. It might then, probably, be explained whether Congreve took the hint for his invention from the Brazilian miners, or whether, in the contrary case, he is to be considered as the real inventor of a method previously known in that country.

In order to arrive at more correct notions of the effects of powder mixed with sawdust, in regard to which no experience had yet (in 1818) been gained in Germany, several experiments were made by M. Thürnagel, of Tarnowitz, and we hasten to lay before our readers the method of procedure adopted on these occasions, for the purpose of demonstrating the practicability of this method, and of thus promoting the general adoption of so important an improvement.

In order to make a preliminary trial, two granite blocks, above ground, were each bored in the usual manner, with one hole in the centre. These blocks were perfectly undecomposed and compact, as may be gathered from the circumstance that sixteen well-tempered chissels were used by skilful workmen in making the two holes, each twenty-three inches deep. The powder was then mixed with an equal *bulk* of sawdust, the loosest sort being selected as likely to ignite most rapidly; and, for the same reason, pinewood was preferred, the sawdust being carefully sifted and then thoroughly dried, so as, on mixing, to produce two essential conditions, the separation of the powder grains and the formation of vacuities, presenting, as it were, continuous air-tubes, and thus allowing of the utmost rapidity of combustion.

The first block was, in dimensions, three feet long, two feet wide, and thirty inches thick; the hole, twelve inches deep, was charged, and closed with clay. On the explosion it was broken into five large and other smaller pieces, one being thrown twenty feet from the spot—a proof of a superabundance of force. The hole, in the last few inches, was made with a chissel of seven-eighths of an inch at the end. The report, on the explosion taking place, was well defined and powerful; but it is to be observed, that some small cracks, which passed through the block, may have contributed to that effect.

The second block, of somewhat larger dimensions, with a similar hole, was charged to four inches: this was burst into two parts, and one of them was turned upside down—another proof of superabundant power. In the fracture no fissures were discernable. These favourable results gave encouragement to trials under ground, among thirty-two of which not one of the cartridges failed to light; most of them had their complete effect, and of the few which did not answer expectation, the causes of failure were sufficiently evident. These experiments demonstrate, that the mixture may be used to great advantage, especially when improvements shall have been suggested and adopted in the various steps of the process, such as changing the proportion of the sawdust, in cases where great difficulties are to be overcome, from one-half to one-third or two-fifths, especially in deep holes, where, by lessening the quantity of sawdust, we proportionally shorten the cartridge, and, consequently, the powder-bag, and leave more room for the action of the charge, which must finally have the effect of augmenting its force. On mixing in equal quantities something is lost in volume, for instance, a cartridge of eight inches and a half, filled with powder, and a similar one with sawdust, would, on being mixed, fill two similar cartridges, if no diminution of volume took place. It has, however, been found that the above quantity only fills a nine-inch cartridge and another of seven inches, making a loss of one inch in bulk. Should the saving of powder by this method be only one-third instead of one-half, which latter the above trials seem to indicate as the general result—yet one-third only would be a saving well deserving the attention of the mining public—and this proportion it certainly reaches to the full extent. Mines which must otherwise be abandoned, might, by this saving, be still continued in work. In the Harz mines the annual consumption of powder was formerly 2400 centner, about 110¼ tons avoirdupois. If one-third only of this weight be saved, it would amount to 800 centner, in value from 18,000 to 20,000 dollars, about 3000*l.*

It may be noticed as a subordinate, yet not insignificant point, that by mixing the powder with the sawdust, before it is given out to the workmen, all misappropriation is avoided. If this method, as we have every reason to anticipate, should be ultimately approved of, this mine (namely, the Friedrick's mine, at Tarnowitz, in Silesia), which requires 100 Silesian cwt. per annum, will need only sixty in future, at the utmost.

The difficulty of obtaining accurate data in the processes of blasting, &c., is sufficiently evident: fair comparisons can only be deduced from experiments with ordnance or small arms; although the expediency of using the mixture in the artillery is not a subject to be discussed in this place. Indeed the same effect may not perhaps be produced in blasting as in the projection of ball grenades or bombs from cannon or mortars.

For the purpose of ascertaining with more precision the effect which the powder, smoke, and vapour arising from the combustion of the sawdust, produced upon the surrounding air, and with the design of meeting the objection that this new plan is inapplicable to mines, on account of the sawdust smoke, a trial was made in the Spes main level of this mine, into which the air is obliged to be introduced by means of pipes, and in which eight candles were burning. Six blasts were made: First, with a cartridge of eight inches, in a hole fourteen inches deep. Second, with one of six inches, in a hole of fourteen inches and a half. Third, with one of eight inches, in a hole of fifteen inches and a half. Fourth, with one of nine inches and a half, in eighteen inches deep. Fifth, with one of nine inches, in eighteen inches and a half deep; and sixth, with one of nine inches, in nineteen inches. The length of the cartridges was left to the option of the mining agent, who was not convinced of the superiority of the new method, and he was requested not to make them longer than when powder alone is used. All these blasts answered expectation, excepting the last, which took effect only in part, yet so that the pick could be very well used. After these six blasts there was no perceptible smell of burnt sawdust, but of unmixed powder only, yet much weaker than in blasting with unmixed powder. There seems, in short, to be no obstacle in the way of employing this mixture in blasting, and we consequently look forward to its general application in all works of that nature.—*Karsten's Archiv.*, vol. 1.

BUILDING OF THE PYRAMIDS OF EGYPT.

In our late notice of a highly valuable and interesting volume, the "Transactions of the Institution of Civil Engineers," we were led briefly to review the progress which has been made by mankind from the most remote ages, in the construction of those stupendous works, designed either for purposes of ostentation or of utility, of which every civilised country presents such numerous and interesting remains, affording, in many cases, almost the sole vestiges of the powerful nations which once inhabited them.

A valued friend, possessing great attainments in classical and Oriental literature, after reading the notice to which we have referred, directed our attention to the account given by Herodotus of the building of the "Pyramids of Egypt," and to the curious fact of a causeway of polished marble (similar, no doubt, in its use and design to the modern railway) having been constructed at immense labour and expense, in order to facilitate the carriage of the stones used for that purpose. The building of this causeway, a large portion of which is now remaining, is stated by the historian to have occupied no less than ten years—and he considers it a scarcely less extraordinary work than the pyramids themselves.

The above passages of Herodotus will form an interesting supplement to our notice of the great works of antiquity before alluded to. We shall therefore proceed to quote it entire, following Beloe's translation of that author:—

"I was also informed by the same priests, that till the reign of Rhampsinitus, Egypt was not only remarkable for its abundance, but for its excellent laws. Cheops, who succeeded this prince, degenerated into the extremest profligacy of conduct. He barred the avenues to every temple, and forbade the Egyptians to offer sacrifices; he proceeded next to make them labour servilely for himself. Some he compelled to hew stones in the quarries of the Arabian mountains, and drag them to the banks of the Nile; others were appointed to receive them in vessels, and transport them to a mountain of Libya. For this service a hundred thousand men were employed, who were relieved every three months. *Ten years were consumed in the hard labour of forming the road through which these stones were to be drawn; a work, in my estimation, of no less fatigue and difficulty than the pyramid itself.* This causeway is five stadia in length, forty cubits wide, and its extreme height thirty-two cubits; the whole is of *polished marble*, adorned with the figures of animals. Ten years, as I remarked, were exhausted in forming this causeway, not to mention the time employed in the vaults of the hill upon which the pyramids are erected. These he intended as a place of burial for himself, and were in an island which he formed by introducing the waters of the Nile. The pyramid itself was a work of twenty years; it is of a square form; every front is eight plethra long, and as many in height; the stones are very skilfully cemented, and none of them less dimensions than thirty feet.

"The ascent of the pyramid was regularly graduated by what some call steps, and others altars. Having finished the first flight, they elevated the stones to the second by the aid of machines constructed of short pieces of wood; from the second, by a similar engine, they were raised to the third, and so on to the summit. Thus there were as many machines as there were regular divisions in the centre of the pyramid, though in fact there might only be one, which being easily manageable, might be removed from one range of the building to another, as often as occasion made it necessary; both modes have been told me, and I know not which best deserves credit. The summit of the pyramid was first of all finished, descending thence, they regularly completed the whole. Upon the outside were inscribed, in Egyptian characters, the various sums of money expended in the progress of the work, for the radishes, onions, and garlic consumed by the artificers. This, as I well remember, my interpreter informed me, amounted to no less a sum than one thousand six hundred talents. If this be true, how much more must it necessarily have cost for iron tools, food, and clothes for the workmen, particularly when we consider the length of time they were employed in the building itself, adding what was spent in the hewing and conveyance of the stones, and the construction of the subterranean apartments?"

Such is the account given by Herodotus of the building of the Pyramids, which, although brief, no doubt describes with accuracy the principal facts of the event, as they had not been erected more than two or three centuries when this historian visited Egypt. Considerable light is thrown upon the text by the notes of commentators, and more especially of those travellers who have visited these stupendous relics of antiquity; some of these notes we shall, therefore, subjoin, believing they will not be without interest to many of our readers:—

"For the satisfaction of the English reader, I shall in few words enumerate the different uses for which the learned have supposed the pyramids to have been erected. Some have imagined that, by the hieroglyphics inscribed on their external surface, the Egyptians wished to convey to the remotest posterity their national history, as well as their improvements in science and the arts. This, however ingenious, seems but little probable; for the ingenuity which was equal to contrive, and the industry which persevered to execute structures like the pyramids, could not but foresee, that however the buildings themselves might from their solidity and form defy the effects of time, the outward surface, in such a situation and climate, could not be proportionally permanent; add to this, that the hieroglyphics were a sacred language, and obscure in themselves, and revealed to but a select number, might to posterity afford opportunity of ingenious conjecture, but were a very inadequate vehicle of historical facts.

"Others have believed them intended merely as observatories to extend philosophic and astronomical knowledge; but in defence of this opinion little can be said; the adjacent country is a flat and even surface; buildings, therefore, of such a height, were both absurd and unnecessary; besides that, for such a purpose, it would have been very preposterous to have constructed such a number of costly and massy piles, differing so little in altitude.

"To this may be added, that it does not appear, from my examination of the pyramids, that access to the summit was ever practicable during their perfect state.

"By some they have been considered as repositories for corn, erected by Joseph, and called the granaries of Pharaoh. The argument against this is very convincing, and is afforded us by Pliny. 'In the building the largest of the pyramids 366,000 men,' says he, 'were employed twenty years together.' This, therefore, will be found, but ill to correspond with the scriptural history of Joseph. The years of plenty which he foretold were only seven, which fact is of itself a sufficient answer to the above.

"It remains, therefore, to mention the more popular and the more probable opinion, which is, that they were intended for the sepulchres of the Egyptian monarchs.

> "Instead of useful works, like Nature, great,
> Enormous cruel wonders crush'd the land,
> And round a tyrant's tomb, who none deserved,
> For one vile carcase perish'd countless lives.—*Thomson*.

"When we consider the religious prejudices of the Egyptians, their opinion concerning the soul, the pride, the despotism, and the magnificence of their ancient princes, together with the modern discoveries with respect to the interior of these enormous piles, there seems to remain but little occasion for argument, or reason for doubt.

"CAUSEWAY.—The stones might be conveyed by the canal that runs about two miles north of the pyramids, and from thence part of the way by this extraordinary causeway. For at this time there is a causeway from that part, extending about a thousand yards in length, and twenty feet wide, built of hewn stone. The length of it agreeing so well with the account of Herodotus, is a strong confirmation that this causeway has been kept up ever since, though some of the materials of it may have changed, all being now built with freestone. It is strengthened on each side with semicircular buttresses, about fourteen feet diameter, and thirty feet apart; there are sixty-one of these buttresses, beginning from the north. Sixty feet farther it turns to the west for a little way, then there is a bridge of about twelve arches, twenty feet wide, built on piers that are ten feet wide. Above one hundred yards further there is such another bridge, beyond which the causeway continues about one hundred yards to the south, ending about a mile from the pyramids, where the ground is higher. The country over which the causeway is built, being low, and the water lying on it a great while, seems to be the reason for building this causeway at first, and continuing to keep it in repair.—*Pococke*.

"The two bridges described by Pococke, are also mentioned particularly by Norden. The two travellers differ essentially in the dimensions which they give of the bridges they severally measured, which induces M. Larcher reasonably to suppose that Pococke described one bridge, and Norden the other.

"VAULTS.—The second pyramid has a fosse cut in the rock to the north and west of it, which is about ninety feet wide, and thirty feet deep. There are small apartments cut from it into the rock, &c.

"THE HILL.—The pyramids are not situated in plains, but upon the rock that is at the foot of the high mountains which accompany the Nile in its course, and which make the separation betwixt Egypt and Libya. It may have fourscore feet of perpendicular elevation above the horizon of the ground, that is always overflowed by the Nile. It is a Danish league in circumference.—*Norden*.

"EIGHT PLETHRA.—To this day the dimensions of the great pyramid are problematical. Since the time of Herodotus many travellers and men of learning have measured it; and the difference of their calculations, far from removing, have but augmented doubt. I will give you a table of their admeasurements, which at least will serve to prove how difficult it is to come at truth.

	Height of the great pyramid. Feet.	Width of one side. Feet.
Ancients.		
Herodotus	800	800
Strabo	625	600
Diodorus	600 some inches	700
Pliny		708
Moderns.		
Le Brun	616	704
Prosp. Alpinus	625	750
Thevenot	520	612
Niebuhr	440	710
Greaves	444	648

Number of the layers or steps.

Greaves	207
Maillet	208
Albert Lewenstein	260
Pococke	212
Belon	250
Thevenot	208

"To me it seems evident, that Greaves and Niebuhr are prodigiously deceived in the perpendicular height of the great pyramid. All travellers agree it contains at least two hundred and seven layers, which layers are from four to two feet high. The highest are at the base, and they decrease insensibly to the top. I measured several, which were more than three feet high, and I found none that were less than two, therefore the least mean height that can be allowed them is two feet and a half, which, according to the calculation of Greaves himself, who counted two hundred and seven, will give five hundred and seventeen feet six inches in perpendicular height.—*Savary*.

AID OF MACHINES.—Mr. Greaves thinks that this account of Herodotus is full of difficulty. 'How, in erecting and placing so many machines, charged with such massy stones, and those continually passing over the lower degrees, could it be avoided, but that they must either unsettle them, or endanger the breaking of some portion of them? Which mutilations would have been like scars in the face of so magnificent a building.'

I own that I am of a different opinion from Mr. Greaves, for such massy stones as Herodotus has described would not be discomposed by an engine resting upon them, and which, by the account of Herodotus, I take to be only the pulley. The account that Diodorus gives of raising the stones by imaginary χωματων (heaps of earth), engines not being then, as he supposes, invented, is too absurd to take notice of. And the description that Herodotus has given, notwithstanding all the objections that have been raised to it, and and which have arisen principally from misrepresenting him, appears to me very clear and sensible.—*Dr. Templeman's Notes to Norden.*

"FIRST OF ALL FINISHED.—The word in the text is ἐξεποιήθη, which Larcher has rendered, 'On commenca revetir et perfectionner.'

"Great doubts have arisen amongst travellers and the learned, whether the pyramid was coated or not. Pliny tells us, that at Busiris people lived who had the agility to mount to the top of the pyramid. If it was graduated by steps, little agility would be requisite to do this; if regularly coated, it is hard to conceive how any agility could accomplish it.

"Norden says, there is not the least mark to be perceived to prove that the pyramid has been coated with marble.

"Savary is of a contrary opinion: 'That it was coated,' says he, 'is an incontestable fact, proved by the remains of mortar, still found in several parts of the steps, mixed with fragments of white marble.' Upon the whole it seems more reasonable to conclude that it was coated."

ANCIENT GOLD COINS FOUND NEAR YORK.—On Tuesday last, as the workmen employed by the York and North Midland Railway Company, were digging in a field on the York side of Holdgate-lane, they turned up a gold coin of the reign of James I., of the current value of five shillings. It bears on one side the head of the monarch, with the Roman letter V, and the following inscription:—JACOBUS—D. MAG. BRI. ET. HIB: REX.; and on the reverse, the royal arms, quartered according to the reign of that king; it is in a fine state of preservation. The same day, the workmen now employed in digging the foundations of the buildings about to be erected in Parliament-street, threw up a gold coin, about the size of a silver penny, which proves to be one of very remote antiquity. On the obverse is the half figure of a bull possessing the head of a man, and the reverse shows an accurate skeleton of a horse, on which is mounted a figure in armour, with a shield on his arm, but there is no inscription or other characters on either side. On reference to "Camden's Britannia," we find similar coins to the one now noticed, were issued about five or six hundred years antecedent to the birth of Christ. It is composed of fine gold, and weighs nineteen grains; both coins are now in the possession of Messrs. Watson and Bell, goldsmiths, of this city.—*Yorkshireman.*

SINGULAR PHENOMENON.—On the 28th ult., at ten o'clock in the evening, an extraordinary phenomenon took place on the shores of the Baltic, in the province of Koeslin, in Prussia. A hill of more than 100 feet in height, and covered with furze, suddenly sank, with a noise resembling thunder. The abyss which has been thus opened, must be at least 200 paces in length. The circumstance produced a movement of the ground in the neighbourhood, by which the adjoining hills were raised from twenty to thirty feet. The cause of this phenomenon has not yet been discovered.

NEW CHANNEL AT THE RIVER NEVA.—A new channel is about being cut at the mouth of the River Neva, with a view of facilitating the navigation between Cronstadt and St. Petersburg.

LONDON AND BIRMINGHAM RAILWAY.

[In our last Supplement we inserted an article from the *Times*, on the subject of the Liverpool and Manchester Railway, which would appear to have elicited the following arguments in favour of the London and Birmingham line, inserted in the *Liverpool Times*, from which we extract it, deeming it only fair to give publicity to the views of all parties; at the same time, we may observe, statements, evidently emanating from interested parties, should be received with considerable caution.]

In addition to the facts already known to the public, respecting the Grand Junction line (Liverpool and Birmingham), which, as is generally known, will open to the public a hundred miles of the communication during the present summer, we are able to state, from inquiries which we have made, that twenty-five miles of the London and Birmingham line, namely, those extending from London to Hemel Hempstead, and thirty from Birmingham to Rugby, will be completed by Midsummer of the present year; fifty-two miles, extending from London to Stoney Stratford, by about November, and that these eighty miles will be immediately opened to the public, the intervening distance of thirty-two miles, being traversed by stage-coaches until the Midsummer of next year, when the whole line will be finished. By this arrangement, one hundred and seventy miles of the two hundred between Lancashire and London, will be open this year, and the whole distance about the middle of next.

In consequence of the unexpected expense of the Birmingham and London line, and the numerous reports circulated to its disadvantage, we have been induced to make some inquiries as to its prospects, in a quarter possessed of the best and most recent information, the result of which we shall take the liberty of laying before our readers, premising that we have no personal interest in the success of the scheme, and no other object than to put the public in possession of facts interesting to all persons, and especially to those concerned in railway enterprises.

First, with regard to the expense of the undertaking. It is generally supposed that the London and Birmingham line is likely to prove extremely expensive, so much so, as to absorb nearly the whole income of the line in interest and expenses, and to leave little profit to the undertakers of it. The truth is, that, even at the increased estimate, it will cost less per mile than the Liverpool and Manchester Railway, and be finished much more substantially than that prosperous undertaking originally was. The total cost of the London and Birmingham will be under 4,500,000*l.*, which, taking the length at 112 miles, gives a cost of 40,000*l.* per mile. The cost of the Liverpool and Manchester line was 41,000*l.* per mile, and it is now paying ten per cent., and has never paid less than eight. On the London and Birmingham, the rails are all of the weight of 75 lbs. per yard, and they rest upon granite blocks; on the Liverpool and Manchester, the rails were originally only of the weight of 35 lbs., and they rested on small red sandstone blocks. The directors on the Liverpool and Manchester line are now laying down rails of nearly the same weight as those used on the London and Birmingham, having found, by experience, that they are the cheapest in the end, and it is thought probable, that there will be a saving of 300*l.* per mile, every year, in the keeping up of the railway, when this change has been effected. These facts, that the London and Birmingham line will cost less than the Liverpool and Manchester, mile for mile, and that it will be upheld at a cheaper rate, will be sufficient to satisfy the public, that the cost is not so large as to render the success of the enterprise doubtful, and also, that the additional expense has been incurred for the permanent advantage of the line.

Supposing the communication and traffic along the London and Birmingham line to be only equal to that along the Liverpool and Manchester, the cost of construction having been shown to be proportionately less, the profits ought to be at least equal. The fact, however, is, that the number of passengers now travelling along the line from London to Birmingham, and *vice versa*, or on parallel lines of communication which must merge in that line, is nearly three times as great as the number passing along the Liverpool and Manchester road previous to the opening of the railway. The number of coaches passing daily along that line was only twenty-four, the number of passengers supposed to be about 500; whilst the number of coaches passing between Birmingham and London, and along parallel routes, is at present sixty-five. There is also a much greater quantity of posting between London and the various northern parts of the kingdom than there ever was on the road between this place and Manchester. Taking the whole number of passengers at 1500, the London and Birmingham begins with as large a number of passengers as the Liverpool and Manchester possesses at present, and will therefore pay as well without any increase. The probability, however, is that there will be a very great increase, and if it should not be to three times the original number, as on the Liverpool and Manchester line, it will still be sufficient to add greatly to the profit of the undertaking. In addition to this, the quantity of goods passing along daily between Birmingham and London amounts to 500 tons. At the present rate of communication the revenue of the line is likely to be at least 500,000*l.* for passengers and light parcels, and 200,000*l.* for goods, giving a total of 700,000*l.*—altogether independent of the certain increase produced by lower prices, and greater facility of communication. Without pretending to calculate the cost of working the railway with precision, there is no reason to suppose that it will be greater on the Liverpool and Manchester, in proportion to the length. Taking it at forty per cent. on the existing traffic, there will remain, after paying all expenses and interest on the two millions borrowed, a clear profit of at least thirteen per cent. on the original shares.

CARN BREA.

[*Continued from the Supplement of March 18.*]

Publius did not confine his views exclusively to mining, but extended them also to commercial affairs, and under his direction, the ancient Cornish became expert navigators, and respectable, if not accomplished, merchants. Hitherto they had been solely dependent on the Greeks and Phœnecians, who purchased their tin, and took it away they knew not whither; but the generous Roman devised a plan whereby they were enabled to obtain a more advantageous market. Shipbuilding was an art unknown in Cornwall; but the natives had constructed boats of boughs and skins, and had learned to manage these apparently fragile barks with astonishing success. It was in these that they conducted their fisheries—the importance of which was second only to that of their mines. The Roman saw and admired this primitive navy; he was pleased and astonished at the dexterity and intrepidity of its managers, and instantly formed the daring resolution of conducting a fleet of these original barques across the channel to the continent. Big with his romantic project, he informed the natives, that by taking their tin to the continental market, they would dispose of it on terms far more advantageous than those which they had hitherto been able to obtain on their native shores: he assured them of the practicability of crossing the channel in their own bottoms; he proffered his valuable services, as convoy to their little fleet to its destination, to superintend the sale of their merchandize in the foreign market, and to conduct them again in safety to their native land. Flattered by the compliments of Publius on their seamanship, and assured by the uniform and complete success of his mining enterprizes, the ancient Cornish readily placed in him the most unlimited confidence, and preparations were readily set on foot for the execution of this novel and romantic enterprize. Such was the success now attendant on the mining system of Publius, that, after freighting the Greek and Phœnecian bottoms as usual, together with those consequent on the Romans' discovery, it was not long ere tin enough remained to freight a pretty numerous fleet of these British barques. The mining proceedings of Publius were well calculated to rouse the suspicions of the Greek and Phœnician merchants, but on witnessing the preparations for this singular maratime expedition, they stood paralyzed at the intrepid zeal of the daring Roman. And well they might! for, although the primitive simplicity of the ancient Cornish prevented them from penetrating the designs of Publius, the knowledge which their old friends had acquired in their intercourse with the world, led them at once to the conclusion, that by this bold enterprize, their talented rival aimed a mortal blow to their hitherto lucrative trade. They well knew, that if he succeeded in carrying this original expedition across the channel, that commercial stream which had so long fertilized their respective countries would be diverted into a new channel, terminating in a reservoir over which they could have no control, and that thus the mercantile greatness, both of Phœnecia and Greece, would be at once annihilated. At length the preparations were complete, the season had arrived, the elements looked propitious, the gallant Roman barque unfurled her canvass to the gentle breezes, leading the way to the first British fleet that ever sailed on mercantile adventure. The welkin rang with loud huzzas from the hardy sons and daughters of Cornubia, who covered cliffs and carns, bidding them God speed, and many hearty salutates greeted them from the summit of Carn Brea. As the time approached in which expectation had taught our ancestors to look for the return of their friends and relatives composing this expedition, the Cornish hills were again daily covered with anxious multitudes, darting their penetrating vision into the distant horizon, and anxiously discussing of their several hopes and fears. It was not long ere they beheld the desired object stretching across the channel towards the desired haven; and the flowing tide, aided by propitious breezes, soon wafted the little fleet safe into the bosom of the ancient *Icta*, and its adventurous and prosperous managers into the more enraptured embraces of their wives and mothers. Their safe return and abundant success was hailed with the liveliest demonstrations of joy; the deafening cheers from "one and all," resounded from cliff and carn, and from shore to shore, until ancient Cornwall literally danced with exultation.

[*To be continued.*]

GEOLOGICAL SKETCH OF ST. DONATS.

[The following interesting sketch of the geological features of St. Donats, in Glamorganshire, and its neighbourhood, by Edward L. Richards, Esq., of Lincoln's-inn, in the form of a letter, addressed to Taliesin Williams, Esq., we extract from the *Merthyr Guardian*.]

It is impossible, within a limited space, to give you any other than a very general idea of the geology of St. Donats and its neighbourhood. Forming, as it does, one of the most beautiful and picturesque portions of our coast, and possessing within its range inexhaustible sources of interest and study to the general inquirer, as well as to the scientific observer, a minute description of its locality, its stratification, order of superposition, and fossil remains, would, doubtlessly, be valuable; but this would be as foreign to the design of your publication, as, I fear, it would be beyond the present means of the friend who has now the pleasure of addressing you. I shall, therefore, confine myself as strictly as possible to the object you have in view, and endeavour to sketch, as faithfully as circumstances will allow me, the general geognostic character of the district in question.

How far the lands of the Stradling family extended, I am not at present aware, but it will be sufficient, I imagine, if we take the space between the district of Sully and the river Ogmore, and as far inland as the junction with the lordships of Fonmon, Llanblethian, and Ewenny. The first formation we meet with in the descending series, and one upon which, in the regular order of superposition, the whole of the oolitic formation rests (classed in the supermedial order of Conybeare, and in the secondary strata of other writers), is the lias limestone. This rock, in its grey and blue state, is very characteristic of the neighbourhood. It occurs, occasionally distorted by the influence of faults, in the inferior strata, but generally in regular order, inclining at a slight angle to the south, alternating with clay slate of a dark bituminous nature, and possessing nodules of argillaceous iron ore, and portions of iron pyrites. At the back of the coast this limestone forms several upfillings, and is found in this position near Cowbridge, Wick, Ewenny, and Bridgend, even to the verge of the great Glamorganshire coal-field. Its fossils are numerous, among which may be found the gryphus ammonites of various species, the trochus, ostrea, pectens, corals, &c., and vegetable substances, mineralized by the sulphuret of iron, silex, and carbonate of lime. Taking Aberthaw as a central point, the lias, abounding in gryphites, and occupying the coast to Porthkerry, on the east, and to Southerdown, on the west, appears to present the upper beds of this great formation, while the lower strata are exhibited eastwards in Barry harbour, and along the cliffs, from Lovernock to Pennarth, reposing on red marle. Throughout this tract the fossils present some most curious and interesting conditions; the gryphites, and other shells, having very generally their original calcareous substance replaced by a chalcedonic deposit. It is very difficult to conceive what cause could have decomposed and removed the calcareous matter of the included shell, and yet have left unaffected the including limestone.

The occurrence of silicious matter is also very rare in the lias of other countries. A similar substitution of silicious for calcareous matter often occurs in the mountain limestone, but that formation always contains an abundant intermixture of layers of chert. Running westward from the neighbourhood of Aberthaw (where is found the blue lias that composes the well-known lime of commerce), we find the bold and beautiful promontories, from Colchue ravine to St. Donats, Nass, and Dunraven, formed of the gryphite lias. At Dunraven it is known as the bluff cliff on which the castle stands, where, in nearly horizontal stratification, it forms, on each side of the cove, mural heights of extreme grandeur, which, when viewed from the sea, with their dark lines of clay slate, become objects of sublime and magnificent attraction. Towards the western termination of the lias, on the coast beyond Dunraven Castles, it assumes a very peculiar character. The lias beds here repose immediately on the mountain limestone, which is often seen breaking out along the beach, as beneath Dunraven headland, under the cove, &c. It is here that the remarkable deposit, called the Sutton stone, is found, which is so beautiful, and of such singular occurrence, as to deserve some attention. It has, at first sight, a semi-vetrified appearance, and is composed of coarse particles of sandstone, quartz, carbonate of lime, and specs of galena. It is easy to work, bleaches perfectly white, on exposure to the atmosphere, and forms the conspicuous stone so frequently found in the coins and window sills of several religious houses and old castles in Glamorgan. Its fossils are numerous, and allied to the lias species, and in mineralized vegetable matter it abounds. For a long period the true origin of this conglomerate was a matter of great uncertainty; but the result of the investigations of Dr. Buckland and the Rev. W. D. Conybeare, has placed the matter in its proper light. I am happy to forward you the substance of a communication I have just received from the latter gentleman, whose long residence on our coast, and distinguished position in the geological world, gives to his assertions the highest authority, and to whose kindness and attention I have been (in common, I believe, with many other young geologists) so frequently and deeply indebted. He states, "that it appears that before any of the subsequent deposits of the new red sandstone and lias took place, the surface of the mountain limestone was covered by beds of shingle, composed of fragments of itself abraded by former convulsions. Whatever formation, therefore, was deposited above such a surface, entangled in its lower portion, this shingle of mountain limestone and became a conglomerate. (The lower conglomerate of the new red sandstone series forms the well-known magnesian conglomerate). When as near Dunraven the lias beds have been deposited on this previous shingle, a very singular lias conglomerate occurs. This appears to be the true origin of the Sutton stone, which, from an examination of its fossils, is clearly referable to the lias formation. Other examples of the lias conglomerate may be seen close to the western gate of Cowbridge. In Somersetshire, also, it may be well studied, at the junction of the lias and mountain limestone, along the south-eastern extremity of the Mendip Hills."

These are the principal coast-features of this interesting district. The inland portion is principally composed of mountain limestone, with, occasionally, thin superveining layers of dolomitic limestone and magnesian conglomerate, containing beds of galena, manganese, calamine, and hæmatatic iron ore. This ridge of limestone forms one of the two parallel zones that encompass the south portion of the Great South Welsh coal-field, and has given rise, from its peculiar position, to the question, "Does the intermediate space between the two ridges, forming the country from the vale of Ely to the Ogmore, now partially covered by horizontal strata of lias, new red sandstone, and magnesian conglomerate, contain a continuation of the great coal series?" Without pausing to enter into this question, I will merely state that the fact of the old red sandstone having been thrust up in several portions of this district, and that it forms an anticlinal line parallel with the limestone the whole way from Monmouthshire to Gower, renders the matter extremely doubtful.

I cannot close this hasty sketch without an allusion to the magnificent caverns of this district, so full of legend and romance, and to the remarkable phenomenon of the never-failing stream of fresh-water which issues from the rock of mountain limestone on the Ewenny river, near its junction with the Ogmore. The latter forms one of the most beautiful instances I have ever witnessed of the water of, probably, a far distant region finding, by this natural subterranean canal, a ready exit to the ocean. It has been a matter of surprise, that the learned and distinguished owner (Sir J. Nichol) of this spot, has not yet applied it to some useful purpose. By inclosing the space around the mouth, and raising the walls, a never-failing power of immense force might be easily obtained. I saw a rock of this kind, near Neufchatel, supply water sufficient for fifty mills, of all descriptions, by merely economising space and regulating the level between the fountain-head and the lake.

DISCOVERIES IN GEOLOGICAL SCIENCE.

This very interesting science, which, as compared with the other great branches of human knowledge, is very young, continues to grow rapidly into deserved importance, through the indefatigable exertions of truly philosophic geologists. From the time when Saussure and Mitchell first directed their attention to the effects of great convulsions on the crust of the globe, together with the progress of chemical philosophy, amongst the mining schools of Saxony and Sweden, the most zealous efforts to develope the history of the mineral constituents of the globe have been made. This led to Werner's system of geognosy, "but it was reserved for modern days, and more refined knowledge of natural history, to establish sound general principles of investigation concerning organic remains, and to unfold the successions of living nature, which constitute the basis of the truths established by Smith and Cuvier." This quotation is so appropriate to our object, that we have adopted it, to show how short a period has elapsed since geology became a subject of high interest to scientific men, and the rapid improvements to which it has attained in about half a century from its commencement. That quotation is taken from the "Treatise on Geology," by Professor Phillips, of King's College, London, which treatise forms a part of the 85th number of the "Encyclopædia Britannica," just published, by Messrs. Adam and Charles Black, of Edinburgh, which we are glad to find is by no means a reprint of the former edition. As the splendid articles by Sir David Brewster, on magnetism, of Professor Jamieson, on mineralogy, and others on the latest discoveries in philosophy, art, and manufactures, sufficiently prove. The volume before us is a proof of what we have advanced, its author has selected and combined all the discoveries which have been made in geology up to the present time, and which disencumber it of certain erroneous notions; it exemplifies the most important facts, by discussing the phenomena in a certain order, under the guidance of admitted general principles, which, being established, the different systems of strata are reviewed in succession, for the purpose of determining the physical conditions under which chemical and mechanical action were put in activity, and have produced the wonderful changes and permanent effects which are visible all over the surface of our solid earth, and in many parts of the ocean. After treating methodically of the stratified and superficial deposits, and volcanic products, the state of geological theory is considered with reference to some great problems which must be solved before any general agreement can be expected amongst geologists. The advantages which works like this are likely to confer upon the great mining interest, and science generally, are, we think, likely to be very considerable, and we think that the proprietors of this new edition of the "Encyclopædia Britannica" deserve much commendation for the spirited and intelligent manner in which they are adding all the most recent discoveries to this edition, at an expense, no doubt, of a very high amount, when we consider the names and characters of the authors who compose the various articles for that important and interesting publication.

Richmond, May 12.—The opening of a literary and scientific institution just established here, under the presidency of the Earl of Errol, took place on Wednesday evening, at the Castle Hotel. It was crowded on the occasion, their being upwards of 200 of the most respectable inhabitants present. Mr. William Chapman, one of the honorary secretaries, read an appropriate address, explaining its objects, and adverting to similar institutions becoming general throughout the country. The address was followed by an introductory and very interesting lecture from Dr. Lardner, which gave the highest satisfaction. He bore testimony to the beneficial results from institutions such as this, and compared the present state of science with its state as pursued by the ancient philosophers. He concluded with several illustrations bearing on the point. The company separated, after congratulating each other on the highly favourable commencement of the society, and the gratifying prospect of its ultimate success, which, with the assistance of the noble president and the vice-presidents, among whom are many distinguished gentlemen residing in the neighbourhood, it cannot fail of accomplishing.

Interesting Discovery.—At a late meeting of the Royal Irish Academy, a paper called "The Antiquities of Tara" was read, being part of a memoir intended to illustrate the new Trigonometrical Survey Map, by which it appears that the strongest evidence has been adduced from MSS. much more ancient than any hitherto cited on the subject, to show that a remarkable obeliscal pillar stone, which now serves as headstone to the grave of the rebels who fell there in 1798, is the so celebrated Lia Fail, or coronation stone of the Irish Kings, which, as it had been generally supposed, was long ago carried into Scotland by the Dalriadic colony, in 503, and thence taken by Edward the First into England, where the stone alleged to be the same is, it is well known, shown under the coronation chair in Westminster Abbey. Previously to this survey no accurate plan of this remarkably ancient seat of the Irish Monarchs had ever been attempted.

Dr. Boase.—We are much gratified to find that our distinguished countryman, Henry S. Boase, Esq., M.D. (late Secretary of the Royal Society of Cornwall), was, on Thursday week, elected a fellow of the Royal Society.—*West Briton.*

The Hundred Largest Cities in the World.—A recent German publication gives the following curious calculation respecting the hundred most populous cities in the world:—These are Jeddo, in Japan, 1,680,000 inhabitants; Pekin, 1,500,000; London, 1,300,000; Hans Ischen, 1,100,000; Calcutta, 900,000; Madras, 817,000; Nankin, 800,000; Congo Ischen, 800,000; Paris, 717,000; Werst Chans, 600,000; Constantinople, 497,000; Benores, 530,000; Kio, 520,000; Su Ischem, 500,000; Hóungh Ischem, 500,000, &c. The fortieth, in the list is Berlin, containing 193,000; and the last Bristol, 87,000. Among the hundred cities, two contain a million and a half, two upwards of a million, nine from half a million to a million, twenty-three from two hundred thousand to five hundred thousand, fifty-six from one hundred thousand, and six from eighty-seven thousand to one hundred thousand. Of these one hundred cities, fifty-eight are in Asia, and thirty-two in Europe, of which four are in Germany, four in France, five in Italy, eight in England, and three in Spain; the remaining ten are divided between Africa and America.

Fossil Bed in the Peak of Derbyshire.—Recently there has been discovered at Darley Bridge, near Matlock, a large and beautiful fossil bed, the strata of which is firmly fixed in an immense rock composed entirely of limestone. The specimens consist chiefly of the oyster and cockle, interspersed with different species of the eel. These fossils are in the highest state of perfection, and upon inspection well worth the attention of those who turn their pursuits to the minutiæ of antediluvian remains. Both the oyster and cockle shells have at different times been detached from the limestone in such a perfect state as to be scarcely distinguished from those newly taken from the ocean.

A Meal of Hay for an Iron Horse.—A few days since a ton of hay was forwarded from this town to Ravenstone, by the railway, and was placed, with other goods, near the locomotive engine. On the road, a few sparks from the iron horse lodged amongst the hay, and in a few moments the devouring fire swallowed up the whole ton, leaving not a single mouthful for hungry cattle, condemned by a long winter to "short commons."—*Leicester Chronicle.*

Artesian Well.—The boring for the Artesian well, at the Abattoir of Grenelle, has got down to 1050 feet, without finding water. The temperature at the bottom, according to the thermometers which have been let down, is 82 Fahrenheit, while at the top it is 59.

Watch Trade in Switzerland.—According to the official returns, there were manufactured, during 1836, at Chaux de Fonds, 17,683 gold and 48,935 silver watches; and Loile, 19,515 gold and 22,262 silver watches—making together 109,295 pocket watches. In this number are not included the skeleton works, completed without cases, or the cases without movements, and which were exported in considerable quantities.

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The Mining Journal

AND COMMERCIAL GAZETTE.

SUPPLEMENT---XIX.

REVIEWS.

Steam Communication with India, by the Red Sea; advocated in a Letter to the Right Hon. Lord Viscount Melbourne, illustrated by plans of the route, and charts of the principal stations. By DIONYSIUS LARDNER, LL.D., F.R.S. Allen and Co.; Hatchard and Son, London. 1837.

In our Journal of last week the work before us received such brief notice as our space would allow, and we now return to it for the purpose of entering more fully into the subject, and treating it at a length more commensurate with the vast importance which must be attached to it, by all who are acquainted with our Eastern possessions.

The acquisition of India by this country, forms one of the most remarkable pages of modern history, and the circumstances attending it, place in a striking point of view the commercial energy and the military and naval prowess of Great Britain. Separated from us by a voyage exceeding half the circumference of the globe—connected but by slight political relations, and never forming an express object of territorial acquisition, as regarded the policy of the British government, it is chiefly owing to the enterprise of a private company of merchants, that the glittering empires of the East have become the tributaries of England—and that India, with her hundred millions of native population, is now governed by a mere handful of Europeans.

The great events to which we have thus alluded belong to history, but there are circumstances arising out of them which form prominent objects of attention at the present moment, and which ultimately concern our own interests. To these, therefore, we shall now proceed, and when we consider the great commercial intercourse existing between India and Great Britain, we feel assured that they must prove interesting to every class concerned, either directly or indirectly, in the commerce of this country.

The government of a distant colony or possession, with a population vastly exceeding that of the Mother Country, differing in religion, laws, and customs, and virtually separated from it by more than half the circumference of the globe, is a political problem of extreme complexity, with which, beyond one or two of those leading principles, which may be said to admit of no dispute, it is not our wish to grapple. There is, perhaps, no political principle more universally acknowledged, or more extensively acted upon, than that it is desirable *to approximate the ruling body to those who are subject to it*—that the distance intervening between them should be virtually lessened to the greatest possible degree.

If we look to ancient times, we shall find that the vast empire of the Romans was chiefly held in subjection by practical attention to this principle. Without the great military roads, which diverged from Rome to every quarter of the empire (even to the extremities of Britain) no effectual communication could have existed between her distant territories, her armies would have been powerless, and her conquests would have been lost almost as soon as they were gained. We need not, however, look to ancient times for the application of the principle above-mentioned, it has been exemplified within the last century by our own Government, and in our island. The Highlands of Scotland were never effectually brought under subjection till after the rebellion of 1745, when roads and facilities of communication were first established through them by the Government. The distance between London and the Sister Isle, although consisting merely of a short land journey, and the crossing of a narrow channel, has long ago received the attention of Government, and been virtually reduced to the greatest practicable extent, by the establishment of the fine Holyhead road, with its noble bridge across the Menai Strait.

Strange as it may appear, the application of this principle to the vast distance intervening between Great Britain and her Asiatic dominions, has hitherto received but little attention, and even at the present moment, although its practicability has been fully ascertained, the lethargy induced by long continued habit has hardly yielded to a perception of its immense importance. To use Dr. Lardner's expression, "how strong must be the force of habit which reconciles us to such a circuit (16,000 miles) to reach a place not 6000 miles distant!"

The evils produced by the present tedious circumnavigation of the Cape, are great and obvious; while this continues, intercourse between Great Britain and India, beyond the limits of *actual necessity*, cannot possibly exist—the social relations of the numerous British residents are unnecessarily broken—the administration of the government of that country is weakened and impeded—while that intercourse between the native princes and the higher classes of the natives generally with this country, which, by giving them a taste for European manners and civilization, would form the strongest bond between our Eastern population and their rulers, is almost entirely prevented.

But apart from all abstract reasoning—let us on this subject consult those who must, from their position, be best informed upon it: let us hear the sentiments of the British residents in Calcutta, the great capital of our Asiatic possessions, as expressed in a circular dated April, 1836, and given in the appendix to Dr. Lardner's work:—"To India," they justly observe, "England is indebted for wealth, for fame, and in some degree for the prominent station she holds among the nations of the world. In return, she has a duty to perform to the countless millions subject to her sway." As regards the introduction of the arts, the sciences, the civilization, and the capital of England, they proceed to observe—"It is her bounden duty to open wide the doors of India, for the entry and spread, EMPHATICALLY, of the knowledge of Europe. It is the one thing needed in India, to enable her to advance, as. *under the dominion of England*, she ought to do, in the scale of nations; and this can only be done effectually *by approximating the two countries in the manner proposed.*"

In the petition of the inhabitants of Calcutta and its neighbourhood to the British Parliament, for the establishment of steam communication between the two countries, it is stated that this object "has been, for several years past, the ardent desire of the whole of the British inhabitants of this country, that this desire has of late years extended to the natives, and that the public wish of all India has been lately expressed in the strongest manner by the voluntary subscriptions of a sum exceeding three lacs of rupees, of which above one lac and a half were subscribed in Bengal alone, a great part thereof by *natives*, for the furtherance of this eagerly-sought measure."

When we add to these strong expressions of the public feeling existing in India on this subject, embracing both the highest public functionaries and the highest classes of native subjects and merchants, the authority of the late enlightened Governor-General, Lord W. Bentinck, who declares—"I have been a zealous supporter of the cause of steam communication with Europe from the strongest conviction, confirmed by every day's further reflection of its vast importance to innumerable interests, both national and commercial." we have certainly made out a case so strong, and possessing such peculiar claims to consideration, as entitles us to look forward with the utmost confidence to a favourable result.

We have been thus explicit in stating some of the leading facts connected with steam navigation to India, because we believe there exists generally a very inadequate idea of the importance of the measure, both as regards our Eastern possessions and the great commercial interests of this country connected with them, and we shall now proceed to Dr. Lardner's work, in which both its expediency and the details of its execution, are ably advocated and arranged. As regards the expediency of the measure, the following extract will be sufficient:—

"It is impossible even for a moment to contemplate this measure without being impressed with the number, variety, and magnitude of the advantages which would arise from it. Our empire in the East contains one hundred millions of souls, the subjects and dependent allies of Great Britain. By the present means of communication, their distance from us is not less than two-thirds of the circumference of the globe. By the proposed measure, that distance would be reduced to less than one-third of its present amount: a virtual change of geographical position would be effected.

"A commerce amounting (exclusive of the China trade) to nine millions annually, would receive that stimulus which commerce always receives from increased facility of communication. A correspondence, the daily amount of which (exclusive of larger despatches) is, even under the disadvantage of being carried round more than half the globe, not less than a thousand letters, would be expedited and proportionately augmented. An army of three hundred thousand men in British pay, now removed beyond those limits which admit of that communication with home which is necessary for the due maintenance of discipline, would be brought under the beneficial influence and immediate control of the home government.

"But great as these advantages may be, they are not the most important national results which would ensue from the proposed measure. The same means by which correspondence with the East would be expedited, will also afford equally increased facilities for personal intercourse. A voyage of several months, exposed to all the dangers of the Southern Ocean, and to the inclemencies of protracted tropical navigations, is a barrier to personal intercourse between distant people, which will be overcome only in cases of extreme need. But when the road to India lies along the shores of Europe, over the quiet waters of the Mediterranean, and amid the splendid monuments of antiquity which adorn Egypt; and when, withal, the time of the passage shall be almost reduced from months to weeks; great indeed would would be the comparative extent of personal intercourse which must ensue. That every increased expedition and facility given to the transport of passengers, is followed by a more than proportionally increased amount of intercourse, is a fact so generally established, that it may be considered as assuming the character of a distinct statistical law. The effect produced by the establishment of steamers between various points on the coasts of these countries, as well as between this country and different parts of the continent, may be adduced as an example of this. But by far the most remarkable instances are those afforded by the effects of railway communication, compared with the previous communication upon turnpike roads. In every case, without a single exception, where a railway has been constructed between two distant places, the intercourse in passengers has increased in a proportion of not less than four to one; nor can this be ascribed to the reduced cost of transport alone, since in cases where the cost has been increased, the same increase of intercourse has taken place. It is, in fact, ascribable to the inducement which increased expedition presents to persons who would otherwise attain their object by correspondents and agents. If, then, analogy derived from unvaried experience, be of any value, and if inferences from it be justifiable, I would here be entitled to assume, not only that all those who now pass between this country and India by the route of the Cape would, on the establishment of steam communication by the Red Sea, adopt the latter route, but that vast numbers who now never attempt the voyage at all, would perform it; that an enormously increased number of persons would pass between the two countries; that the wealthy and enlightened classes of the native population of India would visit this country, and that a reciprocal desire would be manifested among ourselves to visit the East. Much of what is now transacted in each country by correspondence would be then transacted personally; and that diffusion of knowledge, and that spread of liberal principles would ensue, which always attend the intercourse of a less with a more civilized people.

"These are topics which it might be expedient to enlarge upon, were it my purpose merely to excite public feeling in favour of the measure. In addressing your lordship, the slightest allusion to them is sufficient.

"If we except the recent application of the steam-engine to the transport of passengers on railways, there is none of the numerous ways in which that machine has ministered to the uses of the human race which has undergone a more steady and rapid course of improvement than its application to the propulsion of vessels over the sea. There are even now in a progressive state several important improvements, by which its efficacy in navigation will be materially augmented; and if the committee of 1834, from the evidence then laid before them, and from the fact of voyages being made by the Hugh Lindsay during five successive seasons, saw reason to be satisfied of the practicability of the measure, how much more forcibly would they *now* impress their recommendation on government having before them the extended and improved state of the art of steam navigation, and the fact that the voyages by steam between India and Egypt have continued to be successfully made, under the disadvantages of inadequate vessels and defective arrangements at the necessary stations and depôts.

"Nothing but that state of passive acquiescence, generated by a long habit of following a certain course, could reconcile a people so commercial and so locomotive as the English, to be confined to the route to India by the Cape, since the art of transport by land and water has received those astonishing accessions which have been recently conferred upon it by the steam-engine. The distance from Falmouth to the nearest port of India by the Mediterranean and the Red Sea is 5800 miles, of which there are not 200 miles of land, and that through the dominions of a friendly power. The distance usually traversed by sailing vessels in the voyage by the Cape is about 16,000 miles. How strong must be the force of habit, which reconciles us to such a circuit to reach a place not 6000 miles distant!—How over-ruling must that necessity be which sends persons and correspondence a voyage equal to two-thirds of the circumference of the globe, to carry them less than one-fourth of that space! *Primâ facie*, then, my Lord, the question is not, why persons and correspondence should be sent direct to India by the Red Sea, but why for such a purpose the present preposterously circuitous route should be still persevered in."

The following are some of the statistical details requiring consideration:—

"By far the largest amount of intercourse of every kind is maintained, as may naturally be expected, with Calcutta. Of 309,000 letters, which pass annually through the post office between Great Britain and India (including Ceylon), 170,000 are with Calcutta, 71,000 with Madras, 54,000 with Bombay, and 12,500 with Ceylon. Of about 3200 passengers annually between Great Britain and India, about 1450 are with Calcutta, 1050 with Madras, 600 with Bombay, and 100 with Ceylon. Estimating the commerce at nine millions annually, the amount with Calcutta may be taken at five millions and a half, with Bombay two millions and a half, and with Madras one million.

"These results may, therefore, be fairly assumed to represent the exigencies of the different ports of India for the improved means of communication with this country now proposed."

As regards the application of steam vessels to the proposed voyage, and its convenient division into stages, suited to the present capabilities of steam navigation, we have the following judicious observations:—

"In the arrangement of the succession of stages of a long sea voyage by steam, the first object should be to see that the longest stage shall not exceed that distance for which a steam-ship shall be able to carry sufficient fuel, under the most adverse circumstances of wind and weather. It is probable that a well-constructed vessel furnished with the very best machinery, could carry fuel sufficient for a stage of about 2500 miles in average weather; but under more adverse circumstances she would probably exhaust her fuel by a passage of less than 2000 miles. But, besides the consideration of fuel, there are other circumstances to which regard must be had. It is found that the machinery of a steamer requires, after moderate intervals, to be examined and re-adjusted; the fire-places and flues to be swept and scraped; the boilers to be discharged of their contents, and well cleansed both internally and externally. If this process be omitted, or only observed after protracted intervals of uninterrupted work, the machinery will not only be quickly destroyed, but even while it lasts the performance of the vessel will be inefficient; her speed will be diminished, her consumption of fuel will be augmented, and that portion of the fuel which fails to propel her will be actively engaged in working her destruction. In a word, a steam-engine, like an animal, requires regular repose at reasonable intervals; of which being deprived, it ceases to be capable of useful labour. Although, therefore, a stage of from 2000 to 2500 miles be *practicable*, it is not *advisable*; and arrangements should be made, if possible, that the stages be limited to distances from 1000 to 1500 miles.

"A steam-vessel may be considered as doing good duty, if she works on an average about half her time, her periods of work and rest being regulated by the principles which I have just explained.

"For these reasons, when a long voyage by steam is undertaken, on which passengers, despatches, and such light packages only are carried, as may be easily transferred from one vessel to another, it is always mo e advantageous to work each stage by a different steamer, and to transfer the passengers and parcels from one steamer to another at each station, than to continue the same steamer from station to station. By such a process no time will be lost if the stages are long, such as from 1000 to 1500 miles, because, if the whole voyage were performed by the same vessel, she would have on arriving at each station to take in a supply of fuel, and would also have to put out her fires, cool her boilers, blow ont their contents, clean her fire-places and flues, and re-adjust all the working parts of the machinery. This process would be more tedious than that of transferring the passengers, despatches, and packages into another steamer attending in readiness to receive them and start on her voyage, and, in addition to this, it would lead inevitably to the speedy destruction of the vessel from the causes already explained."

It is unnecessary for our purpose to enter minutely into the details of the plan proposed by Dr. Lardner, following, we believe, the suggestions of many of our most able nautical authorities on the subject. It is sufficient to observe, that the route he proposes is by steam-vessels, from Falmouth to Alexandria, from thence overland to Suez—through the Red Sea, by steamers, to Camarin, a port on its borders—thence to the island of Socotra, in the Indian Ocean—steam-vessels to be established from that island to Bombay and Ceylon—the passengers and letters destined for Calcutta being forwarded to that place from the latter stage. These details cannot, however, be well understood, except by reference to the map of the route, which accompanies the work.

To carry this plan into execution, upon an efficient scale, it appears that nine steam ships will be required (two being kept as a reserve, in case of accident); the two between Alexandria and Falmouth are recommended to be of 800 tons burden, and 200 horse power; the five between Suez and the ports of India, of 1000 tons burden, and 250 horse power, the latter being employed on the several stages of the voyage above described.

The following is Dr. Lardner's estimate of the time required for the voyage between India and London, should this plan be carried into effect:—

"Thus the whole time, allowiug for the necessary stoppages between the several ports of India and London, would be as follows:—

Time between Calcutta and London.

	Days.
Calcutta to Suez	30½
Suez to Alexandria	6
Alexandria to Falmouth	16
Falmouth and London . . .	1½
Time between Calcutta and London .	54 Days.

To consider the details of this project minutely—to discuss the various difficulties opposed to it, and the arrangements by which they are proposed to be obviated, would require a degree of knowledge, political, geographical, and nautical, which can only be possessed by few, scarcely, perhaps, by any single individual. It appears to us, however, that the plan now offered has been arranged, after a careful consideration of all these circumstances, and reference to those authorities best acquainted with the local and physical obstacles to be encountered. It may be objected that the overland journey from Alexandria to Suez, and the proposed navigation of the Red Sea, are arrangements liable to interruption from political causes—an argument, certainly not without weight. In the present aspect of political affairs, there is every reason to believe that years may elapse before any impediment of this nature is likely to occur; in the meantime it would surely be folly to lose *altogether* an advantage of such magnitude, merely because we cannot *insure* its perpetuity. Even should the establishment be broken up in consequence of war, the few powerful steamers employed would be of the highest value to Government for other purposes, more especially if adapted, as they certainly ought to be, for defence as well as traffic.

Considering the project merely with reference to expense, which, in these days of too-nicely spun economy and retrenchment, may perhaps be laid much stress upon—there is every reason to believe, from Dr. Lardner's calculations, that it would fully pay its own expenses, and not improbably even leave a surplus.

This is certainly in its favour, but even if the case were otherwise, the first cost of a few hundred thousand pounds, divided between the Government and the East India Company, and a few thousands devoted annually to keeping up the establishment, would be a mere trifle compared to the vast benefits which would arise from it. A measure which would reduce, by more than one-half, the distance intervening between Great Britain and her hundred millions of subjects in India, would be cheaply purchased at any price—it would strengthen, incalculably strengthen, the tenure by which we hold the possession of India, and in assimilating and approximating the inhabitants of the two countries, would greatly enlarge the sphere of British commerce, and give a new stimulus to our extensive commercial transactions with the East.

The American Journal of Science and Arts. Conducted by BENJAMIN SILLIMAN, M.D., LL.D., &c. &c. &c. Vol. XXXI. (for the last six months of 1836). Maltby, Herrick, and Noyes, New Haven. 1837.

The thirty-first volume of this excellent scientific periodical is now before us, and in the value and variety of its contents, is not inferior to its predecessors, although the copious notice it contains of the proceedings of the British Association, at its last meeting, compiled from English journals, is of course no longer interesting in this country.

The first paper in the volume, "Miscellaneous observations, made during a tour in May, 1835, to the Falls of Cuyahoga, near Lake Erie," extracted from the Diary of a Naturalist, we have read with much interest, and would recommend it to the perusal of all our readers who may wish to become acquainted with the geological and physical features of the western confines of the United States, and with the singular incidents and characters to which the border warfare, carried on against the native Indians about half a century ago, gave rise.

Passing over many excellent papers on various branches of science, we shall chiefly extract on the present occasion from the one already alluded to, together with "Remarks on the Geology of Western New York," by George E. Hayes; on "Zinc, as a covering for buildings," by Professor A. Caswell; and one or two others which have more immediate reference to the subjects to which this Journal is devoted.

The following are the introductory passages of the Diary of the Naturalist, and will furnish some idea of American steam-boat travelling, and the scenery of the Ohio:—

"The spring being the most desirable season of the year for travelling, when the mild weather, the fresh green foliage of the forest, and the opening flowers, entice one forth to enjoy their various beauties, I embarked at nine o'clock, on a pleasant evening in May, on board the steam-boat *Detroit*, for a visit to the falls of the Cuyahoga.

"It is now nearly twenty years since the first boat, propelled by steam, was launched upon the western waters. It was built by Captain Shreeve, at Brownsville (Pa.) in that region of country where the earliest improvements were made west of 'the mountains.' It was considered, at that time, as a doubtful experiment. The current of the Mississippi was said to be too powerful to be overcome by steam. The upward commerce on the Ohio and Mississippi, even at that period very considerable, was carried on wholly, in barges and keel boats, propelled by human strength, applied through the cordelle, oar, and pole. The voyage then occupied from three to four months: it is now performed in ten or twelve days. This boat was named the *Washington;* while lying at Marietta, on her downward voyage, she met with a very serious disaster, in the explosion of her immense boiler, by which accident twelve men lost their lives, and as many more were very seriously scalded. Being called immediately on board, to attend on the wounded, I recollect the horrors of that morning, as if it were but of yesterday. At this day few accidents of the kind happen on the Ohio. The engines are better constructed, and built of more durable materials. Instead of one immense boiler, the boats now carry from four to six, of a moderate capacity. The engineers are better educated, and are often chosen from among the architects of the boats. The boats now employed on the river between Louisville and Pittsburgh, amount to nearly one hundred. Many of these are kept in the best order, and for neatness and accommodation, may be safely compared with any boats in America. The crews are subjected to much more strict discipline, since that lawless, independent, but hardy race of keel-boatmen, from whom the hands were formerly chosen, have disappeared from our waters. The genteel manners and civil deportment of most of the passengers, have also a silent, but a sure and perceptible influence on the manners of the crew. Good habits, as well as bad, are easily adopted; and, above all, the banishment of whiskey, that bane of the west, from many of the boats, is doing still more than all other causes combined, for the improvement of morals as well as of manners.

"At nine o'clock this morning the boat passed the mouth of Sun-fish Creek, a small stream falling into the Ohio from the right bank. The hills here are nearly three hundred feet high, much broken and divided by deep ravines into isolated masses. They are now clothed to their very summits with the richest verdure of the forest, and at this season are displaying the various tints of the different species that cluster around their sides—the pure white of the Cornus Florida, and the rich pink of the Celtis Ohioensis, now in full bloom, appears beautifully contrasted with the rich green of the woodlands. For the painter this spot affords some of the finest views that are to be found on the Ohio. The river makes an abrupt bend opposite the mouth of the creek, and opens an extensive perspective of the richest scenery, both up and down the stream. The creek itself is lined with beautiful hills and shady ravines, some of which have given employment to the pencil of Mr. Sullivan, who has produced several masterly pieces taken from this vicinity. He is almost the only painter who has taken living views from the enchanting landscapes of the Ohio. This summer he proposes visiting the cliffs of New River and the valley of the Greenbrier, where some of the most sublime and grand scenery has rested for ages, unnoticed and unknown, except to the passing traveller or the hunter, while chasing the deer amidst these lovely solitudes. No country possesses more rich or varied scenery than the mountain regions on the tributary streams of the Ohio; but in grandeur they may be excelled by the alpine groups of the globe, but in loveliness they are not surpassed."

One of the first places at which the Naturalist halted was Wheeling—the extraordinary defence made by the early settlers at this place against two attacks of the Indians, and the remarkable intrepidity displayed by a female on this occasion, form an episode which we cannot refrain from extracting:—

"The spot of ground where Wheeling now stands was explored in the year 1769, by Colonel Ebenezer Zane, and his brothers Silas and Jonathan Zane, and permanently settled the following year. They removed here from the 'south branch of the Potomac,' near to where the town of Moorfield now stands. The ancestors of the Zane family came over with William Penn, at the first settlement of Philadelphia. Colonel Zane built his first house on an eminence opposite to the island, which stop is now near the centre of the town, and is still owned by his descendents. The Swearingens, Shepherds, M'Cullocks, and John Wetzel, the father of Lewis, who was famous in the legends of hunting and of Indian warfare, were amongst the first settlers of this place. Being, for many years during the Indian wars, the farthest advanced on the frontier, and the most exposed settlement, it suffered much from Indian depredations. It sustained two memorable sieges from the savages, the inhabitants defending themselves with the greatest bravery.

"The first assault was in Sept. 1777, when it was attacked by 380 Indians, headed by the notorious Simon Girty. Colonel Zane, with thirty-three men, assisted by the women, several of whom stood by the sides of their husbands or lovers, and discharged their rifles with fearless intrepidity. Amongst the females was Betsy Wheat, a young woman of German extraction: when Girty urged the garrison to surrender, promising quarters, &c., and there was a parley amongst the men, as to what was best to be done, Betsy answered Girty with all the keenness of female irony—shamed such of the men as seemed disposed to surrender, and infused fresh courage into the disheartened garrison. The siege was continued for twenty-four hours, during which time the Indians kept up a constant fire. Seeing no prospect of success, and fearing an attack themselves from the neighbouring garrisons, they retreated, after destroying nearly three hundred head of cattle, horses, and hogs, and burning the houses in the village, then amounting to about twenty-five dwellings. The consequent distress of the inhabitants was very great, as most of them lost not only their furniture and provisions, but all their clothing, excepting what they had on; the suddenness of the attack giving them no time to remove anything to the fort but their own persons. In this siege some of the garrison were wounded, but none killed; the main loss fell on a reconnoitering party, who, having gone out early in the morning, were ambushed by the Indians, and twenty-three of the number killed in sight of the fort. The loss sustained by the savages was never certainly known.

"The second attack took place in the year 1782. In its results this siege was less disastrous to the whites than the first. The assault was continued for three days and nights, and the defence conducted by Colonel Ebenezer and Silas Zane, with their accustomed coolness and bravery. An interesting occurrence took place during this siege, so characteristic of the heroism of the females of that day, that I cannot forbear narrating it from the 'Border Warfare.' 'When Lynn, the ranger, gave the alarm that an Indian army was approaching, the fort having been for some time unoccupied by a garrison, and Colonel Zane's house having been used for a magazine, those who retired into the fortress had to take with them a supply of ammunition for its defence. The supply of powder, deemed ample at the time, was now almost exhausted, by reason of the long continuance of the siege, and the repeated endeavours of the savages to take the fort by storm: a few rounds only remained. In this emergency it became necessary to renew their stock from an abundant store which was deposited in Colonel Zane's house. Accordingly, it was proposed that one of the fleetest men should endeavour to reach the house, obtain a supply of powder, and return with it to the fort. It was an enterprise full of danger; but many of the heroic spirits shut up in the fort were willing to encounter the hazard. Amongst those who volunteered to go on this enterprise, was Elizabeth, the sister of Colonel E. Zane. She was young, active, and athletic, with courage to dare the danger, and fortitude to sustain her through it. Disdaining to weigh the hazard of her own life against that of others, when told that a man would encounter less danger by reason of his greater fleetness, she replied, "and should he fall his loss will be more severely felt; you have not one man to spare—a woman will not be missed in the defence of the fort." Her services were then accepted. Divesting herself of some of her garments, as tending to impede her progress, she stood prepared for the hazardous adventure; and when the gate was thrown open, bounded forth with the buoyancy of hope, and in the confidence of success. Wrapt in amazement, the Indians beheld her springing forward, and only exclaiming "a squaw! a squaw!" no attempt was made to interrupt her progress: arrived at the door, she proclaimed her errand. Colonel Silas Zane fastened a table cloth around her waist, and emptying into it a keg of powder, again she ventured forth. The Indians were no longer passive. Ball after ball whizzed by, several of which passed through her clothes—she reached the gate, and entered the fort in safety;' and thus was the garrison again saved by female intrepidity. 'This heroine had but recently returned from Philadelphia, where she had received her education, and was wholly unused to such scenes as were daily passing on the frontiers. The distance she had to run was about forty yards. She afterwards married a Mr. Clark, and is yet living in Ohio.'"

The extraordinary scenes and characters of which the "far west" was the scene, at the period when the Indian tribes were yet unsubdued, and slowly retreating before the American back settlers, are so unlike anything with which we are familiar on this side of the Atlantic, that we make no apology for introducing some of them to our readers, in our extracts from the paper under consideration. The accounts given of these scenes by our author are highly interesting, as being, in most cases, derived from eye-witnesses or participators in them—of whom, it appears, several are still living in the wild and romantic region which he visited, and whose local, physical, and geological features, as well as traditionary history, he so well describes in the paper before us.

Some extraordinary adventures of Lewis Wetzel, one of the bold borderers of the back settlements at the period under consideration, are thus described:—

"Amongst the heroes of border warfare, Lewis Wetzel held no inferior station. Inured to hardships while yet in boyhood, and familiar with all the varieties of forest adventure, from that of hunting the beaver and the bear, to that of the wily Indian, he became one of the most celebrated marksmen of the day. His form was erect, and of that height best adapted to activity, being very muscular, and possessed of great bodily strength. From constant exercise, he could, without fatigue, bear prolonged and violent exertion, especially that of running and walking; and he had, by practice, acquired the art of loading his rifle when running at full speed through the forest, and, wheeling on the instant, he could discharge it with unerring aim, at the distance of eighty or one hundred yards, into a mark not larger than a dollar. This art he has been known more than once to practice with fatal success on his savage foes.

"A marksman of superior skill was, in those days, estimated by the other borderers, much in the same way that a knight templar, or a knight of the cross, who excelled in the tournament or the charge, was valued by his contemporaries, in the days of chivalry. Challenges of skill often took place, and marksmen, who lived at the distance of fifty miles or more from each other, frequently met by appointment, to try the accuracy of their aim, on bets of considerable amount. Wetzel's fame had spread far and wide, as the most expert and unerring shot of the day. It chanced that a young man, a few years younger than himself, who lived on Dankard's Creek, a tributary of the Monongahela River, which waters one of the earliest settlements in that region, heard of his fame, and as he also was an expert woodsman, and a first-rate shot, the best in his settlement, he became very desirous of an opportunity for a trial of skill. So great was his desire, that he one day shouldered his rifle, and whistling his faithful dog to his side, started for the neighbourhood of Wetzel, who, at that time, lived on Wheeling Creek, distant about twenty miles from the settlement on Dankard's Creek. When about half-way on his journey, a fine buck sprang up just before him. He levelled his gun with his usual precision, but the deer, though badly wounded, did not fall dead in his tracks. His faithful dog soon seized him and brought him to the ground, but while in the act of doing this, another dog sprang from the forest upon the same deer, and his master making his appearance at the same time from behind a tree, with a loud voice claimed the buck as his property, because he had been wounded by his shot, and seized by his dog. It so happened that they had both fired at once at this deer, a fact which may very well happen where two active men are hunting on the same ground, although one may fire at the distance of fifty yards, and the other at one hundred. The dogs felt the same spirit of rivalry with their masters, and, quitting the deer, which was already dead, fell to worrying and tearing each other. In separating the dogs, the stranger hunter happened to strike that of the young man. The old adage, 'strike my dog, strike myself,' arose in full force, and, without further ceremony, except a few hearty curses, he fell upon the hunter and hurled him to the ground. This was no sooner done than he found himself turned, and under his stronger and more powerful antagonist. Discovering that he was no match at this play, the young man appealed to the trial by rifles, saying it was too much like dogs, for men, and hunters, to fight in this way. The stranger assented to the trial, but told his antagonist that before he put it fairly to the test, he had better witness what he was able to do with the rifle, saying that he was as much superior, he thought, with that weapon, as he was in bodily strength. He bid him place a mark the size of a shilling on the side of a huge poplar that stood beside them, from which he would start with his rifle unloaded, and, running a hundred yards at full speed, he would load it as he ran, and, wheeling, would discharge it instantly to the centre of the mark. The feat was no sooner proposed than performed; the ball entered the centre of the diminutive target: astonished at his activity and skill, his antagonist instantly inquired his name. Lewis Wetzel, at your service, answered the stranger. The young hunter seized him by the hand with all the ardour of youthful admiration, and at once acknowledged his own inferiority. So charmed was he with Wetzel's frankness, skill, and fine personal appearance, that he insisted upon his returning with him to the settlement on Dankard's Creek, that he might exhibit his talents to his own family, and to the hardy backwoodsmen, his neighbours. Nothing loath to such an exhibition, and pleased with the energy of his new acquaintance, Wetzel consented to accompany him; shortening the way with their mutual tales of hunting excursions and hazardous contests with the common enemies of the country. Amongst other things, Wetzel stated his manner of distinguishing the footsteps of a white man from those of an Indian, although covered with mocasins, and intermixed with the tracks of savages. He had acquired this tact from closely examining the manner of placing the feet; the Indian stepping with his feet in parallel lines, and first bringing the toe to the ground, while the white man almost invariably places his feet at an angle with the line of march. An opportunity they little expected, soon gave room to put his skill to the trial. On reaching the young man's home, which they did that day, they found the dwelling a smoking ruin, and all the family lying murdered and scalped, except a young woman who had been brought up in the family, and to whom the young man was ardently attached. She had been taken away alive, as was ascertained by examining the trail of the savages. Wetzel soon discovered that the party consisted of three Indians and a renegado white man, a fact not uncommon in those early days, when, for crime or the love of revenge, the white outlaw fled to the savages, and was adopted, on trial, into their tribe.

"As it was past the middle of the day, and the nearest assistance still at some considerable distance, and there were *only four* to contend with, they decided on instant pursuit. As the deed had very recently been done, they hoped to overtake them in their camp that night, and perhaps before they could cross the Ohio River, to which the Indians always retreated after a successful incursion, considering themselves in a manner safe when they had crossed to its right bank, at that time occupied wholly by the Indian tribes.

"Ardent and unwearied was the pursuit, by the youthful huntsmen; the one, excited to recover his lost mistress, the other, to assist his new friend, and to take revenge for the slaughter of his countrymen—slaughter and revenge being the daily business of the borderers at this portentous period (between 1782 and 1784). Wetzel followed the trail with the unerring sagacity of a blood hound; and just at dusk traced the fugitives to a noted war path, nearly opposite to the mouth of Captina Creek, emptying into the Ohio, which, much to their disappointment, they found the Indians had crossed, by forming a raft of logs and brush, their usual manner when at a distance from their villages. By examining carefully the appearances on the opposite shore, they soon discovered the fire of the Indian camp in a hollow way, a few rods from the river. Lest the noise of constructing a raft should alarm the Indians, and give notice of the pursuit, the two hardy adventurers determined to swim the stream a few rods below. This they easily accomplished, being both of them excellent swimmers; fastening their clothes and ammunition in a bundle on the tops of their heads, with their rifles resting on the left hip, they reached the opposite shore in safety; after carefully examining their arms, and putting every article of attack or defence in its proper place, they crawled very cautiously to a position which gave them a fair view of their enemies, who, thinking themselves safe from pursuit, were carelessly reposing around their fire, thoughtless of the fate that awaited them. They instantly discovered the young woman, apparently unhurt, but making much moaning and lamentation, while the white man was trying to pacify and console her with the promise of kind usage, and an adoption into the tribe. The young man, hardly able to restrain his rage, was for firing and rushing instantly upon them. Wetzel, more cautious, told him to wait until daylight appeared, when they could make the attack with a better chance of success, and of also killing the whole party, but if they attacked in the dark, a part of them would certainly escape.

"As soon as daylight dawned, the Indians arose and prepared to depart. The young man selecting the white renegado, and Wetzel an Indian, they both fired at the same time, each killing his man. The young man rushed forward knife in hand, to relieve the young woman, while Wetzel re-loaded his gun and pushed in pursuit of the two surviving Indians, who had taken to the woods, until they could ascertain the number of their enemies. Wetzel, as soon as he saw that he was discovered, discharged his rifle at random, in order to draw them from their covert. Hearing the report, and finding themselves unhurt, the Indians rushed upon him before he could again reload; this was as he wished; taking to his heels, Wetzel loaded as he ran, and suddenly wheeling about, discharged his rifle through the body of his nearest, but unsuspecting enemy. The remaining Indian, seeing the fate of his companion, and that his enemy's rifle was unloaded, rushed forward with all energy, the prospect of prompt revenge being fairly before him. Wetzel led him on, dodging from tree to tree, until his rifle was again ready, when suddenly turning, he shot his remaining enemy, who fell dead at his feet. After taking their scalps, Wetzel and his friend, with their rescued captive, returned in safety to the settlement. Like honest Joshua Fleeheart, after the peace of 1795, Wetzel pushed for the frontiers on the Mississippi, where he could trap the beaver, hunt the buffalo and the deer, and occasionally shoot an Indian, the object of his mortal hatred. He finally died as he had always lived, *a free man of the forest*."

We have further on an interesting account of the geological structure of the country in the vicinity of "Poland," where a singular deposit, which the author denominates by the no less singular designation of "*semi-tertiary*," is found to prevail. This appears to us to be nothing more than a tertiary deposit, which has suffered extensive denudation by diluvial action, being thus covered and mixed up with its own fragments, and would, perhaps, have been better described by some less equivocal term than the one adopted. The coal deposits in this part of the country are thus described:—

"The coal deposits begin to grow thin, as we approach the table lands between Lake Erie and the waters which run into the Ohio. Over a large portion of this semi-tertiary or diluvian tract, the *upper deposit* of coal has been torn up and washed away, at the period, and by the same cataclysm which covered this portion of the valley with primitive bowlders and tertiary deposits. It is found yet in place in several eminences, and especially at a spot, two and a half miles S.W. of Poland, on the sides of an elevated tract, where it crops out, and six miles further south passes under a tamarack and cranberry swamp of several miles in extent. This swamp lies about one hundred and fifty feet above the general surface of the country north of it. On the sides of this ascent the coal comes to the surface, and is worked, but not extensively. It is about three feet in thickness, and of that quality peculiar to the upper bed all over the valley of the Ohio, being of a slaty structure and glistening fracture, but when burnt in a grate it melts and runs together, obstructing the free passage of the air. It is a good species for coaking, and contains a large portion of carbon for a bituminous coal, it being about sixty per cent."

The fossil plants and shells noticed by the author, are well-figured in some very spirited wood-cuts.

The following passage gives a pleasing view of the state of society in the districts visited:—

"As a mark of the general thrifty and comfortable condition of the inhabitants, it may be stated as a fact, that few, if any, of the counties have need of a poor-house. I was told that more than half of the townships do not assess any poor tax, and in those which do, the sum is very small. The true cause of this exemption from poor rates, the bane of many a fertile portion of the earth, may be found in the industrious, frugal habits of the people, who have generally come from that 'land of steady habits,' which has furnished more inhabitants, and more able and enterprising pioneers to the west, than any other state in the Union. I consider 'the Reserve' as the most valuable portion of Ohio, and look forward to the day as not very distant, when this whole region will be cultivated like a garden, teeming with a million of inhabitants, and studded with towns and villages."

One of the great public works of America, the Ohio and Pennsylvania canal, is thus described:—

"The length of the line of this canal, as reported by Colonel Kearney, of the United States Topographical Engineers, is as follows:

"From Akron, Portage summit of the Ohio Canal, to the Ravenna summit	25 miles.
"From Ravenna summit to Chenango River	67 "
"Total length of canal	92 "

"Total amount of ascent, from the Portage summit to the Ravenna summit, is 107 feet; total descent, from Ravenna to Chenango, is 300; amount of lockage, 407 feet. The breadth of the canal at bottom is 25 feet; at the surface of the water, 40 feet; depth of water, 4 feet.

"'Of the commercial importance of this canal, when finished,' the commissioners say, 'no doubt can be entertained by those who understand the interest and geography of our country. The route passes through one of the best settled and most wealthy districts of our state, and, when executed, it will, together with the Ohio Canal, open a direct and convenient channel of commerce between the interior of Ohio and the great manufacturing and commercial city of Pittsburgh, together with the whole of Pennsylvania. Between those sections of country an extensive and highly beneficial commerce now exists, which must increase with the growing population of our country, and with the development of its resources. It is, however, only by looking forward to the time when the great Pennsylvania Canal, and the Chesapeake and Ohio Canal, shall have connected the Chesapeake with the Ohio River, the Potomac, and the Delaware, that the importance of the Pennsylvania and Ohio Canal can be duly appreciated. When these great works are completed, the farmer, in the centre of our state, may put the productions of his fields on board of a boat, which will convey them to Washington, Alexandria, Baltimore, or Philadelphia, without unloading or reshipping; and the merchant may bring his goods from either of those cities to his own door, without risk or change in the method of transportation, and at an expense not exceeding one-third of the present cost. The profit of this work to the proprietors must be commensurate to its commercial importance; and it is

believed to offer one of the best opportunities for a profitable investment of capital that can be found in the United States.'

"The estimated cost of this canal is about one million of dollars. Departing from its usually wise policy, the state of Ohio has suffered the stock of this canal to pass into the hands of a private company. It is owned in Philadelphia, Pittsburgh, and Ohio, as a portion of it lies in the state of Pennsylvania, from the Ohio line to its junction with the canal on the Beaver, at the mouth of the Chenango Creek. This company was incorporated in Jan., 1827, by the name of the 'Pennsylvania and Ohio Canal Co.,' but the books of the company were not opened until the spring of the year 1835. The stock was immediately taken up, and the canal must be completed on or before the month of April, 1837, or the charter will be forfeited. There is no doubt, however, of its completion within the time specified. The prospect of the immense profits it will yield to the stockholders, and the great advantages to the country, will insure its accomplishment. The following may be enumerated as a part only of its good features. It shortens the distance to an eastern market, from the central parts of Ohio, nearly 250 miles. It is accessible four weeks earlier in the spring, and two weeks later in autumn, than the route by Lake Erie, or the northern route, which will be of vast importance to the farmer and merchant. It is subject to no dangers or delays from storms or head winds, and calls for no expense of insurance on goods. It will also be a feasible route for merchandise going below the mouth of the Scioto, at those periods when the water in the Ohio is too low for safe steam navigation, as it almost invariably is for several weeks in the summer and autumn. With all these advantages, the opening of the Mahoning Canal will be the commencement of a new era in the agricultural and commercial history of 'the Reserve.'"

Our notice has already occupied so much space, that we must again return to Professor Silliman's Journal, in order to do justice to its other valuable contents, and most cordially do we wish that measure of success to this able and talented publication, which we feel to be its due on both sides of the Atlantic.

A Letter addressed to the Directors of the Rio Doce Company. By Mr. J. J. STURZ. Levey, Robinson and Franklyn. London, 1837.

At a late meeting of the Rio Doce company, a report of which was given in our columns of last week, the letter of Mr. Sturz to the directors was alluded to with feelings of satisfaction, which, on glancing over its pages, appear to us to have been well founded, the statements there made, being of the most favourable and encouraging description as regards the great undertaking in which the company is engaged.

By throwing open the navigation of the Rio Doce, now impeded by considerable natural obstacles, a free outlet will be obtained for the produce of one of the most important provinces in the empire of Brazil—produce which from the rugged and mountainous nature of the interior, and the absence of roads, is now either of no value, or conveyed in limited quantities to the coast, at an enormous expense of land carriage. To effect this great object *partially*, as is recommended, and we think wisely; in the first instance, it appears, that no very large outlay is required, and the remunerative results which would almost immediately accrue, are such as would be almost incredible, were not the respectability and good faith of the parties far beyond suspicion.

The large number of shares held in Brazil, the interest taken by the government in the success of the undertaking, as exhibited in the highly favourable nature of the grant made to the company, and other measures, must afford great encouragement, in the vigorous prosecution of the necessary works, from which, according to Mr. Sturz's calculations, pecuniary advantage will be derived at a very early period.

As regards the physical aspect of the rich province of Minas Geraes, we extract the following information :—

"Minas is entirely a country covered with mountains, the average height of which is from 3000 to 3500 feet above the sea; and that, except in its northernmost parts, it has not one plain exceeding two square miles, the body of the land being an uninterrupted extent of mountains and hills, of the above elevation, over which alternate hills and valleys the produce of the interior must be carried, at least eight to ten times, on a journey of 100 leagues;—thus rendering the toil and expense, at any rate, equal to that of double the distance over a moderately level country: 100 leagues thus become equal to 200, perhaps to more, by the comparative exertions required to overcome them; to which must be added the absence of roads, or of any thing deserving that name, and the almost impossibility of any being made for fifty years to come, even of such a description as were general in Europe 100 years ago."

Great advantages are anticipated from the establishment of saw-mills, owing to the former wasteful destruction of timber near the coast:—

"Brazil being a very woody country, all settlements were commenced by felling and burning of all forest; and this mode of destruction has, in former times, been pursued on so large a scale, and so indiscriminately *along the coast*, that in all the towns, planks, timber, and even fire-wood, is scarce and very dear, having to be brought considerable distances from across the country without roads."

Emigration to Brazil is ably treated in an appendix to the letter, in which its importance is made manifest. This subject is well deserving of public attention; Mr. Sturz says :—

"The emigration from Europe to Brazil, already amounts to very nearly 4000 men a-year; and the desire for it in Germany is so strong, that some states, and Saxony in particular, seek to throw obstacles in the way of emigrants."

We can only find space in conclusion for the following passage, which contains much truth, and we cordially hope, that Mr. Sturz will meet with every success in his indefatigable exertions, to make fully known to Europe the vast resources and capabilities of Brazil, and the benefits that must arise from a more extensive intercourse with that country :—

"Millions of the superabundant people of Europe would thus be removed from misery and vice to prosperity and happiness; and the condition of many more millions of those who remained behind would be much ameliorated by the removal of undue competition, in underrated labour, as well as of a baneful competition in the articles of food."

The Railway Magazine and Annals of Science. No. XVI. New Series. June, 1837. Wyld, Charing-cross.

The Number of the "Railway Magazine" now before us, completes the second volume of the new series of this work, for which it contains the title page and index. The "Calculations of the effects of the Atmosphere in resisting a Railway Train," from the pen of the editor, forms the most prominent article, and developes some curious results.

The "Suggestions on the Standing Orders of the House," and an article, on "Proceedings in Parliament on Private Bills, more particularly Railway Bills," are well deserving of attention. The necessity of alteration in the present mode of proceeding must be obvious to all, and was strongly pointed out in our columns of last week, when adverting to the protracted contest of the competing Brighton Lines.

We have more than once regretted to observe in the pages of this periodical a degree of personality, and even coarseness of expression, which is most unbecoming in a work of science, and cannot fail to be otherwise than injurious to its circulation, and to the influence which it ought to possess. In the present Number we should have no difficulty in pointing out some serious blemishes of this kind—defects which, we hope, it will not be necessary for us to comment upon again.

The Engineer's and Mechanic's Encyclopædia. Parts XVII. and XVIII. By LUKE HEBERT, Civil Engineer. Kelly, London.

Our notices of this work during the progress of publication, leave little room for remark, further than to announce the appearance of the concluding parts, and to recommend it to our readers as a cheap and useful compilation on the subjects of which it treats.

EXTRACTS FROM FOREIGN SCIENTIFIC WORKS.

No. XI.

EXPERIMENTS ON THE AUGMENTATION OF THE FORCE OF POWDER BY THE ADMIXTURE OF OTHER BODIES.

BY MR. MAYER,

Mining Superintendent at Gengenbach, near Offenburg, in the Duchy of Baden.

Our Foreign Extracts of this week will be found to contain copious information on the mixture of gunpowder with other substances, for blasting—a subject they have before frequently treated upon. The experiments and theoretical views here detailed, are highly worthy of the attention of our practical mining friends, and will, we believe, be found to throw more light on the subject than any thing which has previously appeared :—

As it may be interesting to such of your readers as are engaged in mining pursuits, to be made acquainted with the various results in different districts, of the method now known for several years of mixing powder with sawdust, in order to obtain increased effect in blasting, I hope it will not be unacceptable to them and to the mining public in general, if I present them the following details of the experiments made in this district; since by comparing these with other trials, improvements may probably be suggested in the method of procedure :—Our first efforts were directed to ascertain the exact proportion of the sawdust to the powder, in order to obtain the maximum of expansive force; and it was found, after numerous trials, that in some of the mines of this district, where 1 lb. of powder was formerly used to make up six cartridges, now nine cartridges are made with the mixture. In other mines of the Grand Duchy of Baden, and particularly in my own official district, one pound of powder used to be requisite to fill eight cartridges, but on being mixed with sawdust, one pound of powder was sufficient for twelve cartridges; and afterwards, on our becoming more skilled in the management of the whole process, sixteen cartridges were made from the same quantity—an increase of one-third, and subsequently of one-half in the number of cartridges—the effect being found equal to what could be expected from powder alone, and failures in the blasts not being more frequent than is usually the case in all mines; of this I have been an eye-witness, in a very great number of instances.

It has been objected that the additional length of the cartridges would render it necessary to work a deeper hole in the rock, so that the increased labour required would in part counterbalance the saving of powder; but to this remark I have to reply, that the superior elasticity of the mixture admits of the six-inch cartridge being pressed down by the clay to the length of four inches only, and consequently in a hole ten or eleven inches deep, there remains six or seven inches for the clay, which is beyond doubt quite sufficient; and it may be observed that the holes are very seldom worked to a less depth than ten to eleven inches. In some places, however, the mixture has not met with the same approbation, but I am not able to state, whether this be owing to a want of correctness and attention in the operations, or to a lurking prejudice against innovation.

The objections which had been brought forward against the sawdust, led me to reflect whether some other substance might not be equally efficient, and an incidental circumstance seemed to indicate the very material. Being out with a shooting party, after firing my piece several times, I found myself at a loss for wadding, and in the hurry of the moment made use of some envelopes of letters, on which there was a more than ordinary quantity of sealing-wax. I had scarcely pulled the trigger, when I experienced a gratification not generally calculated upon by sportsmen—that of being, in no very gentle manner, extended on the turf—and the pain I felt in the shoulder and head, might have made me wish I had postponed the shot till my next excursion, if I had not thought I had made the very discovery of which I was in search, since I naturally attribute the force of the charge to the sealing-wax. On my return home I made some trials, not with the usual component parts of sealing-wax, but with the colophorium (resin) alone. For a bore requiring two ounces of pure powder, I took one and a half ounce, adding the eighth part of an ounce of powdered resin, which was combined with the powder by friction on a sheet of smooth paper, the mixture being indicated as accomplished, when the black colour of the powder assumed a yellowish hue from the resin. Being filled into a cartridge for a hole sixteen inches deep and one inch in diameter, bored in a granite block of great hardness, and two and a half feet long, two feet wide, and two and a half feet high, the cartridge occupied three inches, and the remainder was rammed with heavy spar. The explosion was perfect, and the mass burst into four nearly equal pieces, besides several small ones; one of the former being thrown a distance of four paces. Concluding from this excess of force, and from the well-rounded report, that less powder would do, I tried in a similar hole one ounce of powder to one-sixteenth of an ounce of resin, and I was pleased to find the effect fully equal to what might be expected from two ounces of powder alone.

After these experiments, I found it easy to account for the violent recoil and loud report of my fowling-piece, the resin having produced a more immediate and rapid ignition of the whole mass. It is to be observed, that on using unmixed powder, many of the grains are lost, as is evident from the black streaks discernible after shooting over snow with the gun muzzle near the ground, the piece being held horizontally. These marks or streaks of powder must generally consist of one half of the charge, but similar appearances are not visible on using the mixture. I was now so fully convinced that this last mixture would effect a saving of one-half of the powder, that I immediately introduced the use of it in these mines where it has ever since, namely a year, been used with the same uniform result, and has even been adopted in a colliery, where the managers had previously tried the sawdust without success.

On using this mixture of colophonium, there never occur those so-called (Bichsen), but the whole rock round the hole is sprung from the powder-bag; and moreover, it is observed, that the blast takes effect in almost every case below or behind the bore in the rock itself.

With regard to the expense of the commonest resin, which is what I use, the value of one ounce of it to one pound of powder is very little; and even the finest resin, at two kreutzers the ounce (about three farthings), saves a pound of powder, which usually costs from twenty-four to thirty kreutzers (from 8d. to 10d.)

I next made trials with the *semen lycopodii*, which possesses in a high degree the qualities requisite for the immediate combustion of the powder, but I took only one ounce of it to eight ounces of powder, and found it to produce the same effects as the mixture with sawdust or with resin; but as a pound of this seed will suffice to mix with powder for 512 blasts, I consider that its application may be advisable when it can be procured in sufficient quantities.—*Karsten's Archiv.* vol. iv. p. 125. 1821.

[*Extract of a Letter from Dr. Blumhof, Court and Cabinet Councillor of the Grand Duchy of Hesse, to Dr. Karsten, Editor of the "Mining Archives," and dated in November,* 1818.]

The publication of your Journal is a matter of considerable gratification to me, and to many of the lovers of science, on account of the opportunity which it affords of making generally known the results of labours and observations, made at the most various and distant parts of the world. I make this remark more particularly in reference to the Report inserted in your "Archives," of the experiments made by Mr. Thürnagel, in Tarnowitz, on the new method of blasting with mixed powder.* These trials are highly interesting, and their result completely confirms the similar experiments which have likewise been instituted in this mining district. Immediately upon the appearance of the Brazilian account in the *General German Advertizer*, I commenced a series of similar experiments at the iron-mine of Lixfield, near Giessen, of which the following are the results:—

By the new method of mixing, the mining captain was able to fire thirty-two blasts, from holes of fifteen inches deep, in hard rock, with one pound of mining powder; and one ounce of powder mixed with one ounce of fine dry sawdust from beechwood, had the same effect as if a four-ounce cartridge of powder only had been used. In this instance the saving was three times the amount of the powder used, or seventy-five per cent. It was found that the sawdust should not be too highly dried, but only to a degree sufficient to drive off the moisture; and only the finer particles were made use of, the rest being separated by means of a sieve. The captain noticed that the explosions of the mixed powder were not so loud as of powder alone, and that this new method was not so applicable to mines which were not well supplied with air, since the mixture produces more smoke, and of a more suffocating nature than powder alone.

It is my intention to make these experiments in other mines also; and I propose to communicate to you the results obtained. Since writing the above, I noticed an article in the *Nurnberg New Mining Journal*, edited by Mr. Von Moll, (vol. iv. 1818) in which there is given a description of similar trials with this mixture, by Mr. Selb, Upper Mining Councillor of Wolfach, in the Kinzing-Thal; and as in all probability you have not yet received a copy of the above publication, I take the liberty of giving the substance of his notice in the writer's own words: "I used common fir-deal sawdust," he observes, "passed through a rather fine sieve, and dried so as to leave no perceptible moisture; this reduced it to nearly half its former weight, yet without altering the colour or any other peculiarity. This was added to equal parts of gunpowder, and the cartridges filled in the usual manner, every other preliminary being the same as with powder alone. The effects were such as far to exceed my expectation, whether the blasts were made in the foot or hanging-wall, and I consider that nearly double the quantity of powder would have been required, in order to produce an equal force. About thirty charges were fired, and the conclusion derived from them is, that the same mechanical force may be thus obtained with precisely half the quantum of weight and volume; and yet these experiments are hardly commenced, so that it may be presumed that the proportion of powder may be still further diminished, when the theory and the laws by which the force is regulated become better known, and the practical application of it shall consequently be more accurately directed. The discovery of this method will, doubtless, prove a considerable benefit to the mining interest, and on the score of economy in so expensive an article, well deserves general adoption.—*Ibid.* vol. ii. p. 216.

* For translation of the article referred to, see *Mining Journal* Supplement, No. 90, page 67.

MANUFACTURES.—An analysis of the report of the committee on the exhibitions of French manufactures, &c., has been presented to the Academy of Sciences, by the author, Baron Charles Dupin, Vice-President. The exhibition was the eighth of the kind, and the most extensive and remarkable of all. On this occasion 700 rewards were given, without reckoning previously-acquired distinctions, and honourable mention, &c. The following is a table which shows the extent of the progress :—

Years	1798	1827	1834
Number of exhibitors	110	1631	2447
Rewards decreed	25	425	697
Number of Patents	10	281	576

It is to the increase and dissemination of a knowledge of mathematical and physical sciences, that Baron Dupin attributes this rapid increase.

ANALYSIS OF THE WATER OF THE EGYPTIAN NILE.—M. Regnault, attached to the army of Buonaparte, and a pupil of the celebrated Berthollat, analyzed, with the utmost care, a portion of the Nile water, which was taken up near the island of Rodah, opposite Grand Cairo: 122 hectograms of this water yielded a residue of 21.74 decigrams, which consisted of—

	Decigrams.
Muriate of soda	4.77
Sulphate of magnesia	0.53
Carbonate of magnesia	7.43
Carbonate of lime	5.30
Carbonate of iron	0.53
Silica	1.06
Alumina	1.59
Extractive	0.53
	21.74

M. Regnault also found in another analysis, that 4.89 hectograms of the water contained only 5.4 centigrams of foreign matter, whereas the same quantity of Seine water at Paris, which is celebrated for its purity, yielded 26.5 centigrams, or more than five times as much. These analyses establish the extreme purity of the water of the Nile, with which the water of no other great river will, in this respect, bear a comparison.

PERPETUAL MOTION AGAIN.—By the *Georgia* (American) *Messenger*, we learn that a Dr. Stringfellow, of Macon, has actually discovered the long-sought and never-before-found perpetual motion. The editor thus partially describes it :—"The machine is very simple, the whole consisting of a very few pieces, yet comprising the most ingenious and the most perfect principles of mechanism. It is comprised within a square frame of about eighteen inches, and the parts consist only of two perpendicular spindles, and two horizontal cog-wheels, a trundle head, three small suspension chains, a spiral spring and weight, and a small inclined plane."

LIVE TOAD IMBEDDED IN STONE.—At a limestone quarry at Dogkennels, at Anston, belonging to Messrs. Holmes, the workmen, on breaking up a large mass of rock, lying eight yards beneath the surface of the ground, discovered a live toad imbedded in the solid stone. The animal expired about five minutes after its disentombment.—*Derbyshire Courier.*

POPULATION OF SWITZERLAND.—The amount of the population of Switzerland, according to the general census ordered by the Diet of 1836, amounts to 2,177,429, of all sexes and ages.

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—May 17.

Rev. W. Whewell, President, in the chair.

A paper, by Mr. Peace Pratt, F.G.S., commenced on the 3rd May, entitled "A Description of the Geological Character of the Coast of Normandy," was resumed and concluded.

On referring to the previous accounts by Mr. De la Beche and Mons. de Caumont, he confines himself chiefly to those points which appear not to have been accurately described.

The chalk cliffs which bound the coast between Cape Antifer and Cape la Heve are composed of chalk marl, and rest upon a bed, forty or fifty feet thick, of green sand. To these succeed alternations of argillaceous beds, with ferruginous deposits, which appear to indicate the presence of the Gault and Hastings sand. These rest upon an argillaceous limestone, separated into thin beds by portions of clay, of which the upper layers contain *Gryphœa vingula*, *Ostrea deltoidea*, and these, therefore, represent the Kimmeridge clay. In consequence of a fault, bringing down the argillaceous deposit called argile d'Honfleur to the level of the shore, it has been assumed that this also was equivalent to the Kimmeridge clay, like the deposit on the northern shore of the Seine, although it really overlies the iron sand.

The Kimmeridge clay again makes its appearance near Cricque Bœuf, and is seen resting on a calcareous rock, which the author considers equivalent to the coral rag formation, and that they do not represent the Portland beds. Near the mouth of the Toucqua a deposit of clay rises from beneath the calcareous strata, containing *Gryphœa dilatata* and *Ostrea gregarea*, and therefore representing the Oxford clay. This forms the cliffs as far as Dives, and is seen near the mouth of the Orne, overlying a calcareous oolitic rock, which is usually considered identical with the Cornbrash, but in fossil remains approaches much nearer to the forest marble of the West of England. They overlie two beds filled with fossils, chiefly *Terebratula digona* and *plicata*, *Avicula inæquivalvis*, *Apiocrinites rotundus*, *&c.*, and therefore representing the Bradford clay.

The Caen freestone is usually considered to represent the Great Oolite of the West of England, but the few fossils found in it resemble those of the Inferior Oolite.

Lias is distinctly seen for a few hundred yards, forming the base of the cliffs near St. Honorine.

Hence Mr. Pratt concludes, it would appear from this rapid view, that nearly the whole of the strata found between the chalk and the lias in England are found on the coast of Normandy; the Portland, and perhaps the Purbeck beds, with the Kelloway rock, only not being seen in this part of France.

A paper by Dr. Mitchell, F.G.S., was also read, describing a well dug at Beaumont Green, on the premises of Mr. Munt, a magistrate for the county (Hertford), in which chalk was reached at the depth of 126½ feet, a spring met with forty feet lower, but the excavation was continued for seventeen feet below the spring to form a reservoir. The most remarkable stratum in the section was one fifteen feet thick of blue sand with black pebbles. This in very wet weather was found to emit foul air, and in such quantities as to suffocate a well-digger when descending; a hawk, flying over the well, fell into it, and a similar fate befel smaller birds, as well as bees and flies. Dr. Mitchell has no doubt that the foul air was sulphuretted hydrogen gas, formed by the decomposition of water and iron pyrites. The neighbouring district to the extent of four miles is called "Foul country" by the well-diggers. Nothing remarkable was observed in the well during dry weather. Its safety has since been secured by bricking it from the chalk up to the surface.

A paper was also read "On some recent Elevations of the Coast of Banffshire;" by Mr. Joseph Prestwich, jun., F.G.S.

That an uplifting of the shores of the Murray Firth has taken place subsequent to its having assumed its present outline, is proved by the existence, in several places, of a raised beach. In Banffshire, its height above the present high-water level, varies from six to twelve feet. It occasionally abounds with shells now inhabiting the adjacent seas, such as *Patella vulgata*, *P. lævis*, *Trochus ziziphinus*, *Littorina littorea*, and *Turbo retusus*. To this upheaving of the land, the author attributes the draining of the former lowlands, as he conceives is indicated by the remains of drained peat mosses. A section of one of these presented a total thickness of about five feet, including two irregular layers of gravel and quartz grit, with freshwater and land shells.

In a paper on the Gamrie Ichthyolites, read before the Society in April, 1835, Mr. Prestwich stated, that having been informed of the occurrence of lias in the dark clay and sands, which in many parts of Banffshire cap the old red sandstone and schistose rocks, he had inferred that these beds might be outliers of lias. Having, however, subsequently visited that country, and examined that deposit, at Blackpots and Gamrie, he found the lias fossils in separate masses, and associated with rolled fragments of the older rocks. He also met with, at Gamrie, in a bed of light-coloured sand, alternating with dark clay and beds of gravel, the following recent shells:—*Astarte icotica*, *Tellina tenuis*, *Buccinum unda*, *Natica glaucina*, *Fusus turricola*, *Dentalium dentalis*. They were extremely friable, but perfectly uninjured. This deposit or drift attains in some places a thickness of 250 feet, and rises to a height of 350 feet.

In conclusion, the author attributes the origin of this drift to a denudation of the lias and older formations; and he infers, from the perfect preservation of the fossils and the superposition of the beds, that its accumulation was gradual.

Wednesday, May 31.

Rev. W. Whewell, President, in the chair.

Extracts were also read from two letters from Sir John Herschel, F.G.S., from the Cape of Good Hope, the first to Charles Lyell, Esq., dated Feb. 20, 1836, and the second, in explanation of this, to R. I. Murchison, Esq., of the date of Nov. 15, 1836. In these the author, taking for granted a high degree of central temperature in the earth, which many geologists admit, and with which all are familiar, proceeds to explain his views respecting the necessary consequences of the transfer of pressure from one part to another of the earth's surface, by the degradation of existing, and the formation of new continents, by pursuing into its consequences, according to admitted laws of this hypothesis, of a high central temperature. His object being to get a geological *primum mobile*, in the nature of a *vera causa*, and to trace its working in a distinct and intelligible manner.

Thus assuming an equilibrium of temperature and pressure within the globe, the isothermal strata, or curves of equal temperature, will be spherical, but where they approach the surface, will by degrees conform themselves to the bottom of the sea, and the surface of continents. If, therefore, we suppose these isothermal strata under the bottom of any great ocean to be parallel to its concavity, when this comes to be filled up, the bottom may become horizontal, or even bulge out into a convexity, and the equilibrium of temperature will be immediately disturbed, because the form of a stratum of temperature depends essentially on the boundary surface of the solid above it. The temperature, therefore, will immediately begin to migrate from below upwards, and the isothermal strata will gradually change their form from the concave to the horizontal or convex form. The former bottom of the ocean will then acquire a temperature corresponding to its then actual depth, while a point as much below it as itself is below the surface, will acquire a greatly higher temperature, and may become even melted. Hence, therefore, instead of saying, as heretofore, "Let heat from below invade (for which no reason can be assigned) newly deposited strata, then they will expand, melt, &c.," we may commence a step higher, and say, "Let strata be deposited then, according to known, regular, and calculable laws, heat will gradually invade them from below, and will expand or melt them as the case may be." But if from the inequality of pressure some support gives way, a crack may take place, extending upwards, and a piece of the solid crust break down and be plunged into the liquid below; this will, from the simple hydrostatic pressure, rise into the crack above. But as it gains height it is less pressed; and if it attain such a height that the ignited water can become steam, the joint specific gravity of the column is suddenly diminished, and a jet of mixed steam and lava will be forced up, giving rise to all the phenomena of earthquakes and volcanos. But if all goes on in quiet, the only consequences will be the obliteration of organic remains, and lines of stratification, &c., and the formation of new combinations of a chemical nature, &c.—in a word, the production of metamorphic, or stratified primary rocks.

INSTITUTION OF CIVIL ENGINEERS.—May 2.

James Walker, Esq., President, in the chair.

Mr. Oldham, of the Bank of England, was elected a member.

The Ordnance maps of England and Wales were presented from the Master General and Board of Ordnance. The President announced that Mrs. Chapman had expressed her intention of making the Institution the depository of the valuable professional plans, drawings, &c, of the late William Chapman, of Newcastle.

A paper, by Mr. Bald, on the velocity of the water in Belfast Harbour, containing calculations respecting the quantity of water supplied to the Laggan river, and tables of the velocity of the ascending and descending currents at different states of the tide, was read.

A model of the centre employed in the construction of Chester Bridge, having been presented by Mr. Trubshaw, many observations were made on the manner in which this, the largest stone arch in the world, had been built. The waste of timber in this centre was exceedingly small; timbers from twenty-two to thirty-four feet in length were only bored with one or two holes; so that the whole loss on the centre, including the cost of labour, did not amount to more than 700*l.*

Some discussion then took place on the method adopted by Messrs. Macneill, in laying down a railway. By this method of projection the positions and extent of cutting and embankment are shown at once; a shaded part above the line of railway represents the cutting, and a shaded part below the line the embankments. The terms acclivity and declivity being employed, and a rate being marked after them, information sufficient for ordinary purposes is conveyed at once by a single section, similar to that used in one of the charts in Stevenson's Bell Rock Lighthouse, to show the depth of the sea at different parts of the German Ocean. Two different lines being laid down in this manner, the eye will frequently detect at once the reasons for choosing one in preference to the other.

Mr. Harrison presented a drawing of the drops employed at South Shields, and gave an account of the performance of the locomotives on the Stanhope and Tyne Railway. It had been ascertained that the quality of the coal used influences very much the wear of the tubes. If, for instance, the coal contains much sulphur, the tubes will leak in a very short time; therefore, that is selected which contains the least quantity.

Mr. Carneghie gave an account of the recent improvements in the stone-planing machine. Many specimens of the Craigleith and other hard stone had been dressed, and the ease with which the machine dresses the stone is such, that the labour of putting the stone on, and of taking it off, is the principal thing to be considered. Some remarks were also made on a new boring machine. A member had seen a hole bored in three minutes, by one man, five inches deep, one and a half inch in diameter, in a hard sandstone. Holes could be bored by this machine in about one-fifteenth the time occupied in boring them by the methods now employed.

May 9.—The President in the chair.—The Ordnance maps, county Meath, were received from the Lord-Lieutenant of Ireland. A paper, by Mr. E. H. Palmer, on the application of steam as a moving power, considered especially with reference to the reported duty of the Cornish engines, was commenced. The object of this paper is to show that highly elastic steam cannot be applied as economically as atmospheric steam. Mr. Palmer first considers what is the maximum effect which can be produced by a given quantity of atmospheric steam, and then, reasoning from certain principles in physics, some of which are recognized as established, he infers that highly elastic steam, worked expansively, cannot produce even an equal, much less a greater effect. Mr. Palmer assumes that twelve cubic feet of water can be converted into atmospheric steam by 84lb. of coal; the steam so generated, occupying many thousand cubic feet, can be applied to produce a vacuum, and we shall have about 44½ million lb. raised one foot high by this quantity of steam. But if this is to be applied through the intervention of machinery, some allowance must be made for the loss due to friction and other causes. This correction being made, Mr. Palmer obtains about twenty-six millions as the maximum effect which can be produced by this given quantity of atmospheric steam.

Mr. Palmer then proceeds to consider the position, that the high-pressure steam, produced by the same quantity of fuel, must be less efficacious than atmospheric steam, and he takes the following laws as the basis of his argument:—That the sum of the latent and sensible heat in steam, whatever its pressure, is a constant quantity. That all matter, steam of course included, absorbs caloric on dilating. That though equal quantities of water require equal quantities of fuel to convert it into atmospheric steam, it does not follow that all the caloric absorbed in high-pressure steam is exclusively supplied by the fuel expended. That steam of double, treble, or more atmosphere elasticity, is not composed of double or treble the volume of water contained in an equal volume of atmospheric steam; but contains proportionately less water as the pressure is higher at which the steam is generated.

The preceding principles were illustrated and insisted on in great detail; and the author concludes that the high-pressure steam, generated by a given quantity of coals, cannot, when worked expansively, perform so much duty as the atmospheric steam, from the same quantity of fuel, unless steam can dilate without sensible caloric becoming latent.

May 23.—The President in the chair.—The paper by Mr. E. H. Palmer, on steam, was concluded. Considerable discussion took place on the question of the actual duty which engines were doing in pumping water, and several members undertook to ascertain the fact of the duty actually done by some of the best engines in London and its neighbourhood, and to report to the Institution on the subject.

A paper, by Mr. Bald, on blasting the white limestone on the Antrim coach road, was read. This paper contains sections and descriptions of the white limestone; the depths and diameters of the borings; the quantity of gunpowder used per cubic foot; with tables of the quantity of gunpowder required for opening blocks of given dimensions.

BIRMINGHAM LITERARY AND SCIENTIFIC SOCIETY.—May 1.

This society commenced its meetings on the above evening for the ensuing session, at the Institution, in Cannon-street.

R. W. Gem, Esq., President, in the chair.

The President opened the business of the evening by an excellent address, in which he congratulated the society upon its increasing importance and usefulness.

The officers for the present year having been elected, Dr. Ward read a paper upon the Icthyosaurus, recently purchased by the Philosophical Institution. The writer first pointed out the adaptation of the forms of vertebrate animals to the state of the earth at the period of their creation, from the first deposition of the remains of fishes in the slate rocks, to that of the whales and mammalia of the tertiary strata; gave an outline of the unerring principle by which Cuvier was enabled to describe the form and habits of animals, of which he possessed but the fragment of a bone; traced the affinities of the Icthyosaurus to the fishes, Plesiosauri, whales, crocodiles, and that anomalous animal the Ornithorynchus; and concluded by exhibiting the remarkable state of preservation of the present specimen, of which not only the earthy substance of the bones remains, but even the flesh and skin of the animal are preserved in the form of a layer of carbonaceous matter. The discussion upon the paper stands adjourned till the 22nd inst.

Royal Asiatic Society.—At the meeting of this society, on Saturday week, the secretary announced a munificent donation of one thousand pounds from Major-General Sir Henry Worsley, K.C.B., who accompanied his gift by a letter, in which he expressed his wish to dedicate a portion of the bounty he had received from the best military service in the world to the promotion of the objects of the Royal Asiatic Society, one of which is the communication of the knowledge and civilization of Europe to India, which country was the principal field of the gallant general's military services. The meeting acknowledged the donation by a special vote of thanks, and a general feeling prevailed among the members that they should mark their sense of the liberality displayed by a subscription for a bust of the donor, to be placed in the society's meeting room.

De Dunstanville Memorial.—At a meeting of the Institute of British Architects, on the 29th of May, there was exhibited, from C. Manby, Esq., a drawing of a monumental cross, erected near Redruth, to the memory of the late Lord de Dunstanville, composed of 30,000 cubic feet of granite, the cost of which was 15,445*l.*; it was commenced in May 1835, and finished in February 1837.

EXTRACTS FROM A CORNISH SURVEYOR'S MANUSCR[IPT]. BRIEF AGRICULTURAL VIEW OF CORNWALL.

[From a Correspondent.]

The magnitude of the mines in this county, in some measure divert[s] public attention from its agricultural concerns; but the importance of [this] branch is much greater than is generally considered, and the rents obt[ained] are higher than in most other parts of the kingdom for grounds of the [same] quality, which is owing to several obvious causes. The lands are divided [into] small farms, allowing great competition among a numerous body of [the] working husbandmen of small capital. The county being nearly surrou[nded] by the sea, and intersected by many navigable creeks and rivers, pre[sents] great facilities of obtaining manure, and carrying off the produce; and [the] populousness of the mining districts occasions great demand for agricul[tural] produce.

The average sizes of the farms are from forty to sixty acres—many of [them] are only about twenty; comparatively, few amount to one hundred a[cres], although there are some of several hundreds of acres. These few large f[arms] being scattered about the county, and occupied by men of capital, secur[e] the needful convenience of introducing agricultural improvements in [the] district. * * * * * *

In an agricultural point of view, the county may be divided accordin[g to] its geological formation. There are several ranges of granite hills form[ing] the most elevated parts of the county, covered with what may be term[ed] gravelly soil; which soil in general extends beyond the granite formation[s and] covers some of the surrounding slaty grounds. The easternmost of t[hese] ranges extends from the banks of the Tamar westward, to Kit Hill, [near] Callington. The next, Roughtor and Carraton Moor district, ext[ending] from near Camelford on the north, to near Liskeard on the south. The [next] is the Hensbarrow district, extending from near Lostwithel to the wes[t of] St. Austel. Next to which is the Carn Menelis district, extending [from] Redruth to near Penryn, and westward to near Helstone. About three m[iles] west of Helstone is the Tregoning Hill district, extending from the clif[fs of] Breage northward, to Godolphin Hill. The last is the Land's End dist[rict], extending from St. Ives and near Penzance to the Land's End and Cape C[orn]wall, occupying nearly all the peninsula west of the Hayle River. The S[cilly] Islands may also be considered as another of these districts, the forma[tion] being wholly granite. The granite or *growan* soils are more or less grav[elly], owing to the numerous crystals of quartz mixed with them, which are [de]rived from the decomposition of the granite; but their general qualities [are] various, which probably arises from the different proportions of felspar [and] the quartz, as where the quartz abounds, the soil is poor. These soils ar[e in] general better adapted for grass than corn, nevertheless there are tract[s of] good arable land on the granite. The remaining parts of the county are p[rin]cipally slaty formations, of various descriptions, covered with soils of [very] different qualities, which difference may be owing in a great measure to [the] various compositions of the stone. Greater part of the slaty grounds [are] good arable lands, and furnish excellent pasturage for sheep, even where [the] soil is very thin, as it is for many miles in extent near Padstow and [St.] Columb. The sides of the steep hills in these, as well as the granite grou[nds], are many of them covered with furze, which is usually cut at five, six, or s[even] years growth, and sold for fuel.

A large district in the north-eastern part of the county, including the co[un]try about Stratton, and extending from the cliffs for some miles inland, [ap]pear to be of a strong clay soil, resting on a formation of clay slate. [The] soil throughout this district appears to be greatly overcharged with c[lay], and a great deal of it very coarse, yet it contains several tracts of good ar[able] and pasture lands. Intersecting the slate grounds, are many formations [of] greenstone and hornblende rocks, for the most part ranging in a sort of ir[re]gular direction, nearly parallel to the borders of the granite, and in so[me] places close to it. These formations are accompanied by good soils, wh[ich] are in general better for grass than corn. Part of the district of Menea[ge], extending from the cliffs near the Manacles Point westward, through [the] parish of St. Keverne, is of syenite formation, accompanied by an excell[ent] soil. Contiguous to this formation is a large tract of serpentine, extend[ing] from the cliffs about the Black Head westward, to the cliffs facing Mount's B[ay], and northward to near St. Martin, the soil on which is miserably poor, [and] is in a great part unenclosed, forming the Downs of Goonhilly, Lizard, a[nd] Pradanack. This district is famous for its beautiful heaths. The serpent[ine] does not extend so far south as the cliffs at the Lizard, as a tract of two [or] three hundred acres, forming the promontory, is greenstone slate and mi[ca]ceous slate, covered with a good soil.

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There is no extent of low meadow ground in Cornwall. The valleys [are] very narrow and numerous, and a stream runs through each of them, so t[hat] there is but little ground that is far from water. The general system [of] change of crops exists to a prejudicial degree. Except immediately ro[und] the towns, very little ground is kept up as permanent pasture; not even s[uch] as would, with proper management, form excellent meadows. Although th[ere] are many streams unemployed, which might convert some thousands of ac[res] into fine watered meadows, at a trifling expense, such improvement is ne[g]lected; and in places where water has been employed, it has been often d[one] in a slovenly and injudicious manner.

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Notwithstanding that many of the Downs or Commons have been r[en]dered very poor, and almost destitute of vegetable soil, by having from t[ime] to time the turf skinned off for fuel; great quantities of these grounds h[ave] been enclosed and improved in and near the mining districts, principally [by] the miners, who have generally taken from three to six acres each, on wh[ich] they have built a cottage, and many of them keep a cow, and grow potat[oes] and a little corn for their families. In some situations on the granite grou[nd] it has cost immense time and labour in clearing away the rocks and ston[es], and heaping them in rows so as to form fences to the little plots—two or th[ree] thousand tons per acre have been removed from some spots to clear the grou[nd]. In many places in the valleys, spots have been enclosed which were form[erly] turned over by the tin streamers, where nothing appeared to remain but he[aps] of stones; these have been levelled, and the earth which was buried care[fully] preserved and laid again on the surface, and now form good meadows.

Chalk Formation.—At the last meeting of the French Academy [of] Sciences, it was stated, that such is the great thickness of the ch[alk] formation on the left bank of the Seine, that in boring for water t[hey] have reached the great depth of 1,200 French feet, which is equal [to] 1,300 English, without meeting with it. It is proposed, however, t[hat] the work should be continued, on the calculation that if it should not [be] obtained until the boring instruments have reached to a much gre[ater] depth, the expense will be compensated by obtaining an inexhaust[ible] supply of water at such a degree of temperature as to supersede the [use] of fuel in the great bathing establishments of the city. At 1,200 feet [the] registering thermometers mark twenty-three degrees, five of the ce[nti]grade scale, and at 2,000 feet it is estimated that the heat will not be [less] than twenty-five degrees.

New Adelaide Gallery.—It is not generally known that a [new] Gallery, upon a very extensive scale, is building in the rear of Cavend[ish]-square, in Regent-street.

New Scientific Apparatus.—On Thursday week, after the clos[e of] the Adelaide Gallery to the public, Mr. J. F. Goddard exhibited t[o a] select number of scientific gentlemen a new apparatus of his own in[ven]tion for polarizing the hydro-oxygen light without the aid of tourmali[ne], and which being adapted to the microscope showed all the beautiful p[he]nomena of this splendid branch of optical science. Various film[s of] selenite displayed their complimental colours in a brilliant manner, [and] from wedges of the same bands of colour were shown vicing in brillia[ncy] with the solar specirum. Two discs, one red, the other green, b[eing] made to revolve, showed where they overlapped, that their colours w[ere] complimental and produced white light. Mr. Goddard was war[mly] thanked by Earl Stanhope and others present.

A Live Rat Imbedded in Stone.—A few days since, as two mi[ners] of the names of Jonathan Thompson and George Douglas, were occu[pied] in blasting a drift in a strata of solid stone, called the scar limeston[e, at] Alston Moor, six fathoms below the surface, they shot into a small ca[vity] of the rock, out of which, to their surprise, sprung a full-grown rat. [The] miners endeavoured to take the animal alive, but in their attempt to [do] so it was killed. How long the rat had been imbedded in its living gr[ave], and in what manner it had contrived, in such a situation to exist (c[on]sidering the organic formation of the animal), are questions that mus[t be] left to conjecture. On examination, the strata around the cavity [was] found to be perfectly solid and close in every part.—*Newcastle Jour[nal].*

The National Debt.—By a return of the House of Commons, d[ated] the 19th instant, the amount of surplus revenue and interest on d[ona]tions and bequests applicable to the reduction of the national debt, [ap]pears to be as follows:—Between 5th July 1836, and 5th July 1[837], supply bills, 1,771,900*l.* 15s. 7d.; stock, 188,823*l.* 12s. 1d.; slave c[om]pensations, 50,000*l.* Total, 2,010,724*l.* 7s. 8d.

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